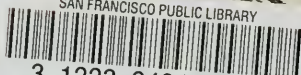
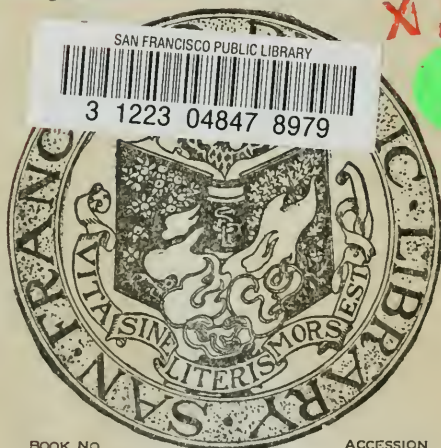


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PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



A PEEK AT MT. SHASTA
FROM THE McCLLOUD RIVER

Vol
17

JULY 1927

No
1

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Pacific Service Magazine

Volume XVII

Number 1

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Contents for July, 1927



WIGGINTON ELLIS CREED	Frontispiece
WIGGINTON E. CREED—IN APPRECIATION	F. A. Leach, Jr. 3
STORY OF A LIFE OF ENERGY AND RESOURCE	4
PUBLIC MEN EXPRESS SYMPATHY	5
MELONES POWER PLANT ADDED TO "PACIFIC SERVICE" SYSTEM—SUCCESSFUL COMPLETION OF A COMBINED POWER AND IRRIGATION PROJECT	F. S. Myrtle 6
COMMENTS BY THE PUBLIC PRESS	12
PIT FOUR DIVERSION DAM COMPLETED AND IN SERVICE	14
LAKE FORDYCE IS NOW SECOND LARGEST RESERVOIR IN SYSTEM	19
THE STORY OF POWER IN CALIFORNIA ADDRESS BEFORE THE FRANKLIN INSTITUTE	A. H. Markwart 23
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 30
EDITORIAL	34



Wigginton Ellis Creed

Born February 8, 1877

Died August 6, 1927

PACIFIC SERVICE MAGAZINE

Volume XVII

JULY, 1927

Number 1

Wigginton E. Creed—In Appreciation

By FRANK A. LEACH, JR.

Wigginton E. Creed, President of Pacific Gas and Electric Company since July, 1920, died Saturday morning, August 6, 1927, aged fifty years.

His passing has taken from the world of development and progress a truly notable figure. During his comparatively brief period of life on this earth he built up an enduring record of worthwhile accomplishment, and he brought honesty of purpose as well as determination to succeed to bear upon every task he undertook.

He entered the "Pacific Service" family a comparative stranger to the greater part of its personnel, but it was not long before he was personally known to one and all. From the first he bent his energies toward acquiring a complete knowledge of our company's working organization in all its branches, as well as of its financial structure. His grasp of every situation that presented itself for consideration was marvelous, and not the minutest detail escaped him. He was captain of our ship from the first and he was the sort of captain that knows his vessel from stem to stern, from masthead to keel.

He effected the present system of departmental interconnection under which our company's business is conducted. He planned ahead always and he was never afraid to take what to conservative minds might seem a bold step. To his resolution and encouraging influence during his seven years of leadership may be credited the most striking features of the "Pacific Service" record in the way of extensions and betterments of service to the consumer. Under his masterly guidance the public service structure grew with unusual rapidity and, with that growth, there came to be established a more and more solid feeling of sympathy and understanding between the public service and the public it serves.

He was a strenuous worker and he had no use for the idler. Yet, he was a just and kindly man. He interested himself in the personal affairs of those under him and to the humblest worker in the company he accorded the kindest personal consideration. His passing at the zenith of his marvelous powers is a terrible blow not merely to the several industrial organizations with which he was officially connected, but to the world of industry at large.

His home life was ideal. Such relaxation as he permitted himself to take from the never-ceasing calls upon his energies he enjoyed in the company of those nearest and dearest to him. To the loved ones he has left behind, we who knew and loved him send humble message of loving sympathy that comes straight from the heart.

Story of a Life of Energy and Resource

Wigginton Ellis Creed was a native of California, born in Fresno, February 8, 1877. His father, William Henry Creed, was a prominent attorney of that city. While he was still of tender years his family moved to Oakland and there young Creed mapped out his course of life. From the public schools he passed into the University of California, where he took up the study of law. He graduated in 1898. In due course he was admitted to the bar of California and commenced practice in San Francisco. In 1902 he became a member of the firm of Titus, Wright and Creed.

During a number of years of successful practice he made a close study of public utility administration and banking, and it was not long before he attracted the attention of the great captains of industry on the western rim of this continent. He came into special prominence in 1915 through being chosen to straighten out the tangled affairs of the Peoples Water Company in Oakland. In the prosecution of this task his ability as an organizer came to the front, the result being the incorporation of the present East Bay Water Company and Mr. Creed's election to the presidency, an office he occupied for two years. And so it came to pass that when, in July, 1920, the late Mr. F. G. Drum decided to resign the presidency of Pacific Gas and Electric Company, his unerring eye picked out the man to succeed him. On July 28, 1920, the Board of Directors of "Pacific Service" accepted the resignation of Mr. Drum and elected Wigginton E. Creed in his place.

To what skill, to what earnest application, to what masterly resource he brought to bear upon his leadership, the story of our company's progress in the past seven years bears ample testimony. He had other interests, too, which made demands upon his time and energies. He was president of the Columbia Steel Corporation of Pittsburg, Contra Costa County; president of the wholesale lumber company of C. A. Hooper and Company; president of the Contra Costa County Bank of Pittsburg; director of the Wells Fargo Bank and Union Trust Company, Associated Oil Company, and East Bay Water Company. He was connected with a number of charitable institutions. For eight years he was a trustee of the California Institution for Deaf and Blind. He served a term as president of the University of California Alumni, and in that capacity sat on the Board of Regents of the University of California. He was also a trustee of Mills College. His wide reputation as a student of economics gave him the honor, in 1921, of Weinstock lecturer at the University of California.

He found little time to play, but when he did he liked the open. In addition to the Pacific Union, University and Faculty, he was a member of several country clubs.

In 1904 he married Miss Isabel Hooper, of Alameda, who survives him, as do his four children, Isabel, Patricia, Elizabeth and Marjory. Mrs. Georgie C. Posey, of San Francisco, is a sister, and Mr. William H. Creed, also of San Francisco, is a brother.

Public Men Express Sympathy

No sooner had the news of Mr. Creed's untimely death gone out to the world than messages from public men in various parts of the country came pouring in to company headquarters. The following are among the earliest received:

"He was a great leader in the industry. No one has been more progressive in initiating things which were right or more courageous in opposing things which were wrong."—OWEN D. YOUNG, Chairman of the Board, General Electric Company, New York.

"He had endeared himself to our whole industry by his conspicuous qualities of heart and mind."—GEORGE B. CORTELYOU, President, Consolidated Gas Company, New York.

"The industry has lost one of its outstanding figures and I personally, an associate whose friendship and judgment I valued most highly."—H. T. SANDS, National Electric Light Association.

"California will miss an able citizen who did much to insure better living and we of the public utilities will mourn an associate from whom we all took counsel and whose wonderful example it was a privilege to follow."—A. B. MACBETH, President, American Gas Association.

"He was an outstanding and lovable man who will be greatly missed by all who knew him."—JOHN J. O'BRIEN, President, H. M. Byllesby & Co., Chicago.

"Your company has lost a great executive and the industry one of its outstanding men."—MARTIN J. INSULL, President, Middle West Utilities Company, Chicago.

"In the passing of Mr. Creed the electrical industry has lost a man of great vision and sterling character."—W. A. JONES, Vice-President, Doherty Securities Company, New York.

"He was a great man and none knew him but to love him."—J. F. OWENS, Vice-President and General Manager, Oklahoma Gas and Electric Company, Oklahoma.

"The industry has lost an outstanding figure and a forceful executive."—E. D. KILBURN, Vice-President, Westinghouse Electric and Manufacturing Company, New York.

"His loss will be felt not only on the Pacific Coast but throughout the country."—C. M. CLARK, E. W. Clark & Company, Bankers, Philadelphia.

"Many of us are better and more useful men because of him and his influence on us. His spirit of leadership and influence for good will long be felt."—LESTER S. READY, Vice-Chairman, Key Transit Company, Oakland.

To the foregoing may be added the two following statements issued to the public press on the day of Mr. Creed's death:

"In the death of Wigginton E. Creed, San Francisco loses an outstanding, public spirited citizen, whose passing will be mourned by all of our people.

"Mr. Creed was a great builder, and in his field attained an eminence such as is won by few men. Educated at the University of California, of which he was one of the foremost alumni, he engaged in a career during which he assisted in the harnessing of the water power of the high Sierra and its transformation into electric energy, and during which he helped build up a great institution known the length and breadth of the Pacific Coast.

"In the name of our people I extend profound sympathy to the family of Mr. Creed."—JAMES ROLPH, Mayor of San Francisco.

"Mr. Creed was one of the big men in the public utilities field, not alone of California, but of the entire nation. He was distinctly Californian in his vision and built large. His work in the development of his company into the largest gas and power utility in America will be a fitting monument to his memory."—LEON O. WHITSELL, Acting President, California Railroad Commission.



Melones Power House, on the Stanislaus River below Melones Reservoir

Melones Power Plant Added to "Pacific Service" System

Successful completion of a combined power and irrigation project in which the farmers and the power interests co-operate for their mutual benefit.

By FREDERICK S. MYRTLE

Melones power-house, on the Stanislaus River a short distance below Melones dam, was officially placed in operation June 11th last, and thereby our company's electric power generating and distributing resources were increased by 36,000 horsepower in installed capacity.

Moreover, by this latest piece of hydro-electric construction work "Pacific Service" fulfilled its part of a co-operative compact which seems destined to be the forerunner of many of similar character. By it the farmers of a large and fertile section of the San Joaquin Valley and the power interests operating in that section were brought together in a business agreement for the common benefit of all concerned, and long-standing disputes concerning water rights upon the Stanislaus were settled for all time.

Readers of PACIFIC SERVICE MAGAZINE have already been advised of the particulars of this agreement. The way was paved for it many years ago, when the lack of sufficient impounded water to encourage proper agricultural expansion in the territory supported by the Stanislaus River watershed first engaged the attention of the officials of the Oakdale and South San Joaquin Irriga-

tion Districts. These districts were organized in the year 1910, under the Wright Act, acquiring their water rights upon the Stanislaus by purchase of the old Tulloch system, consisting of ditches and flumes and a small power plant at Knight's Ferry, since abandoned. The first construction work accomplished was the Goodwin dam, on the river eighteen miles upstream from Oakdale, and in 1913 water for irrigating purposes was first delivered by the districts from the Stanislaus. The territory embraced by the districts is a fruitful one, including large tracts of agricultural territory in the counties of Stanislaus and San Joaquin and lying between the cities of Stockton and Modesto. The gross irrigation area is given at 145,258 acres and the area under irrigation, at the present time, at 108,271 acres. So, as pop-



The power-house is a modern structure of the latest design.

ulation increased and more lands were irrigated and a greater variety of crops raised, it became evident that the natural flow of the Stanislaus was not sufficient to give full service during the five irrigating months of the year. In an effort, therefore, to remove the handicap under which they suffered and to provide water for late summer and fall irrigation the officials of the two districts proceeded to extensive investigations of available reservoir rights.

These investigations were conducted over a period of years dating from 1916, and selection was finally made of a site at the head of the Iron Canyon, a short distance from the old town of Melones, where the river forms a natural gorge. It was decided to dam the river at that point with a concrete arch-type structure 210 feet in height above the stream bed and 585 feet long on the crest, thereby creating a reservoir of some twelve miles in extent and of an estimated storage capacity of 112,500 acre-feet. But there were difficulties in the way, mainly financial, and it was not until the officials of the power interests operating in that territory sat down with the directors of the irrigation districts that real headway was made.

Negotiations, of course, looked to the sale of water by the irrigation districts to the power companies for power purposes, but there had been long-standing disputes between the farmers and the power interests over water rights on the Stanislaus, and there seemed no way open for amicable adjustment of these until Mr. Wigginton E. Creed, representing the Pacific Gas and Electric Company, as its president, and, also, the Sierra and San Francisco Power Company, whose properties our company had been operating for some years under a lease, suggested to the directors of the irrigation districts a partnership of interest and accommodation. Said Mr. Creed: "Our business is the power business; we have been thirty-five years in developing some of the best technical brains of this country. You want to build a dam on the Stanislaus River. We are warring over the waters of that river. You are going to take a long time to learn



Interior of Melones power-house.

about the power business, and it would take us a long time to learn about the irrigation business. Why not make a treaty? Why not settle the work upon the Stanislaus? Why not work in harmony, you doing the irrigation business and we the power business?"

A happy note was struck. The result was a joint agreement between the parties in interest, formally executed January 15, 1915. The irrigation districts, on their part, agreed to proceed with their proposed dam, at an estimated cost of \$2,200,000, and the power companies, on their part, agreed to erect a power plant, to be called the Melones plant, at a point about a mile downstream from the dam and to be operated by water diverted thereat; the plant to cost \$2,500,000 and to be capable of generating approximately 40,000 horsepower of electric energy. The companies agreed to pay the districts for the use of the water to operate this plant a total sum of \$5,175,000 in semi-annual installments of \$64,687.50 each stretching over a period of forty years, which amount, it was calculated, would be sufficient not only to pay the interest on the water bonds by which the irrigation dis-

tricts proposed to finance their dam construction, but, also, to amortize the entire issue within the period stated.

The war on the Stanislaus was over. The irrigation districts submitted the contract to the people of the districts for their ratification, and this they effected on May 18th, 1925, by carrying a special bond election at which the sum of \$2,200,000 was voted for the water storage development work. Construction was started without delay and was prosecuted with such celerity that the Melones dam was completed in the fall of the following year. It was formally dedicated November 11th, 1926, and at the ceremonies incident to the occasion President Creed of our company and Messrs. D. O. Castle and H. S. Crowe, presidents, respectively, of the South San Joaquin and Oakdale Irrigation Districts, made addresses and exchanged congratulatory greetings. A feature of the occasion was the reading of a message from Secretary of Commerce Herbert Hoover at Washington, congratulating the interested parties upon their "practical co-operative spirit which has enabled the public districts and the public utility to successfully work out by agreement a constructive and beneficial project."

Early in the present year the waters were spilling over Melones dam, and at the time of writing the reservoir is brimful.

Meanwhile, our company's engineers had lost no time in starting work on the "Pacific Service" end of the agreement. The districts' construction work stopped at the irrigation outlet 400 feet below the dam, at which point the power development project had its beginning in the form of a concrete-lined tunnel 4,400 feet in length, of horse-shoe shape 12 feet in diameter, and of 1500 cubic feet per second water-carrying capacity. Tunnel boring was naturally a long



View on the Stanislaus below the power-house.

job, but the end of 1926 saw it completed and the work of lining with concrete in process. From the downstream end of the tunnel two very short pressure tunnels, each $8\frac{1}{2}$ feet in diameter, were constructed to take the place of penstocks in carrying water to the turbines in the power-house on the river bank. Work on this structure was started in good time, and the close of 1926 saw the foundations dug, the steel frame in place and concrete being poured. Next came the work of installing the electric generating equipment, consisting of two turbines of a total installed capacity of 36,000 horsepower, direct connected to two vertical shaft generators of 27,000 k. v. a. total capacity. Outside the building a bank of four transformers, three in use and one spare, constitutes the equipment for "stepping up" the power generated at the plant at 11,000 volts to a voltage of 115,000 for transmission a distance of $7\frac{1}{2}$ miles to Copperopolis, the nearest point of contact with the Sierra and San Francisco Power Company's transmission system, thence to that company's principal distributing substation at Manteca, where the transmitted electric energy is poured into the "Pacific Service" pool, to the manifest benefit of electric users in the surrounding territory, particularly the irrigation area controlled by the districts.

It is agreed that the districts shall control the river flow from March 1 to November 1,

each year, the power companies the remainder of the year. After the water passing through the Melones plant has served its purpose of power generation it is returned to the Stanislaus River, down which it flows a distance of eight miles to Goodwin dam, at which point it is diverted into the districts' canals for distribution to irrigation users below. At the conclusion of the period of forty years, when the

stipulated payments will have been completed, the power companies will enjoy perpetual use of the water from the dam for power generation, the sole charge upon them being that of bearing costs of maintenance equally with the irrigation districts.

An additional benefit to the irrigation districts lies in contributions of additional



View of Melones dam and 112,500-acre-foot reservoir.

stored water from the Sierra and San Francisco power system's reservoirs at Strawberry and Relief, in the Sierra Nevada mountains east of Sonora. Last year, when the stream-flow in the Stanislaus dropped extremely low, our company made up the deficiency in the supply for irrigation purposes by drawing upon Strawberry and

Relief to the limit of their capacity, turning the water over to the districts without charge.

The opening ceremonies at Melones powerhouse on June 11th were attended by leading officials of "Pacific Service," the presidents and directors of the irrigation districts and a large number of invited guests, including some 200 editors of newspapers circulating in northern and central Califor-



The dam spilling water in the early part of the year

nia. Former State Senator Charles P. Cutten, of our company's law department, made the dedicatory speech, in which he expressed the company's appreciation of the harmonious spirit of co-operation on the part of all parties concerned that had helped so materially in the successful prosecution of the project. Mr. John Hancock, attorney for the South San Joaquin Irrigation District, spoke for the agricultural interests and expressed words of cordial congratulation upon the establishment of a practical partnership between the 25,000 interested residents of the two irrigation districts and the many thousand stockholders of the Pacific Gas and Electric Company. Miss Hazel McFarland, publisher of the *Folsom Telegram*, pressed an electric button that started one of the giant turbines and the Melones power-plant was officially placed in operation. Mr. R. E. Fisher, our company's Vice-President in charge of Public Relations and Sales, presided at the ceremonies.

A procession of automobiles carried the entire party out from Stockton by way of Oakdale and Knight's Ferry to a point on the Sierra railway, whence a special train completed the journey. After the ceremonies, which included luncheon and an inspection of Melones dam and power-plant, the party returned to the highway and proceeded by way of Jamestown, Sonora, Co-

lumbia and Angels Camp to Stanislaus, the controlling plant of the Sierra and San Francisco Company's system. There in the evening a program of entertainment was given at which Mr. F. A. Leach, Jr., First Vice-President and General Manager of the company; Mr. A. F. Hockenbeamer, Second Vice-President and Treasurer; A. H. Markwart, Vice-President in charge of Engineering, and Mr. P. M. Downing, Vice-President in charge of Electrical Construction and Operation, made addresses. Mr. Homer Wood, publisher of the *Petaluma Courier*, spoke in behalf of the visiting journalists and expressed appreciation of the opportunity the power company had afforded by this and other excursions to get first-hand information concerning power development in northern California. The evening closed with a highly enjoyable vaudeville show presented by Mr. Charles S. Northcutt, our company's Manager of San Joaquin Division.

The return cityward was made the next day by way of Angels and San Andreas. The entire trip proved interesting to all who participated, for the way lay through country of romantic memories, immortalized by Bret Harte, Mark Twain and others who lived the rough life of the mining days and left behind them an imperishable record.



Stanislaus, the controlling plant of the Sierra & San Francisco Company's System.

Comments in the Public Press

The Melones project demonstrates a principle that farmers primarily interested in water for irrigation and power companies primarily interested in water for power, although adhering to their primary interests, can aid each other.—*Contra Costa Gazette*.

A great dam impounding water and a power-house generating electric energy stand today as lasting monuments created by co-operation.—*Golden Gate News*.

The outstanding memory of this year's trip is that wonderful co-operative plan whereby a vast area of agricultural land is assured abundant irrigation for all time to come while, at the same time, a great power company has the right to use the same water for the production of electric energy that is now and always will be needed on that same land.

I have never heard of a more sensible or more practical plan, and it will always be tremendously interesting to watch the future progress of this co-operative enterprise.—*Mountain View Register-Leader*.

The agreement between the irrigation districts and the power company is one of the very few of its kind recorded in the United States, embodying some new ideas in water and power development. It creates a lasting monument for the farmers and the power companies.—*Sunset Courier*.

With an abundant supply of water for late and frequent irrigation, farmers in both districts see an opportunity for expansion and an economic improvement such as has never before been offered.—*Benicia Herald*.

This is the first known project of its kind, and our people are so well satisfied with conditions that we are advertising it to the world, and no doubt other communities will follow along similar lines. Where it has been customary heretofore to be able to see nothing good in a big, soulless corporation, we have formed full partnership with one and are working harmoniously with it.—*Ripon Record*.

The farmers of two irrigation districts vitally concerned over the need of a more dependable source of supply of water for irrigation joined with a power company primarily interested in power development and successfully worked out what has proven to be a unique and practical way of solving an important agricultural problem.—*Byron Times*.

Such a trip is worth while to any one living in California because it brings to realization the actual workings of co-operative progress and service.—*Gerber Star*.

The Melones development—a practical demonstration of confidence and co-operation.—*Oakdale Leader*.

As rose the hum of one of the two big turbines the machinery seemed to sing an anthem of such glorified common sense as is implied in the Golden Rule.—*Los Gatos Star*.

Man has scored another victory, harnessed another river, and farmers of this generation are expected to have cause to look back proudly to an achievement.—*San Francisco Chronicle*.

The system linking farmers and the power companies and the storage and use of Stanislaus River waters is one of the most novel and effective in the history of water-power development.—*San Jose Mercury-Herald*.

Now that the trail has been blazed, there will be other co-operative projects. Other farming communities will have available without cost huge bodies of water for their thirsty lands. The lands will become populous with farmers, eager customers for the product of the power company. Surely an arrangement of much mutual benefit.—*Oakland Express*.

A splendid illustration of the new spirit in business, which calls for co-operation among men in the development of resources which can be used for mutual benefit.—*Cloverdale Reveille*.

While *The Journal* has never looked with favor upon the various power bills that are continually being brought before the people to vote upon, it will have less regard for them in the future after seeing how the P. G. & E. handles the hydro-electric situation.—*Salinas Journal*.

The old-time "to hell with the people" class of corporation is of the past. Today Mr. and Mrs. Small Customer are a part of the corporation.—*Sonora Banner*.

The days of the romance of gold have passed into history, but a new romance is being written there today that will far outstrip the feverish gold rush. White gold is being yielded by the same mountains and streams that yielded the yellow gold. The romance of water is writing history there today.—*Esparto Exponent*.

In these days of stupendousness, co-operation, and service it is becoming increasingly difficult to impress even the moderately blase soul—particularly the news gatherer whose daily diet is well seasoned with these common ingredients, which so often take the form of words.

When stupendousness, co-operation, and service so impress the sophisticated you may believe something resembling a miracle has taken place. And that is what happened a few days ago. The Pacific Gas and Electric Company is responsible.—*Palo Alto Times*.

Not simply because it is another great irrigation and power project is the Melones Dam with the related power-house important; its major interest inheres in the fact that the farmers of the two irrigation districts will get their water for nothing. The sale of the power from the impounded water to the Pacific Gas and Electric Company will return to the districts more than \$5,000,000 over a period of forty years; will retire bonds and meet interest charges.—*Western Advertising*.

While the Sierra Nevada mountains ordinarily represent a great waste land, since it is a vast territory that is uninhabitable, particularly in the winter time, yet there comes from these snow-capped peaks, vast amounts of water every year, which, when used for the development of electric energy and for irrigation purposes produces vast wealth in the lowlands below. It is such development that is now going on through the instrumentality of the Pacific Gas and Electric Company that is of strong interest to all the people of this state.—*Petaluma Courier*.

No question now before the people of California is of greater import than that of conservation and distribution of water which is engaging so much of the time of our legislators. That the interests of power and irrigation are allied rather than antagonistic has been amply demonstrated at Melones, where two irrigation districts have entered into an agreement with a public service corporation for the use of stored water in power development before it goes to the lands of the irrigationists.—*Oroville Register*.

The beneficial use of water is certainly maintained in such an agreement and results in prosperity to all parties in agriculture and industry.—STATE SENATOR THOMAS INGRAM in the *Grass Valley Union*.

Water is in nowise changed by going through a penstock. Under this agreement it turns wheels and irrigates land in two districts, one of 72,000 acres and the other of 74,000 acres. The San Joaquin Valley districts have water as a result of an investment which will pay for itself with the sale of power rights and the company has a power plant worth \$2,500,000 from which energy will be distributed throughout Central California.—*Oakland Tribune*.



The newly constructed diversion dam at Pit Four development. Upper view shows upstream face, tunnel intake at the right; lower view is of downstream face.

Pit Four Diversion Dam Completed and in Service

The diversion dam at Pit Four development was completed and put in active service on May the 11th last, one year and seven months from the date of starting preliminary work and exactly one year from the time when the waters of the Pit were diverted by a temporary dam to permit the work of excavating the foundations for the permanent structure.

The construction of this latest link in our company's comprehensive chain of water-power developments in the Pit River region presented engineering features of an unusually interesting character. It is an engineering axiom that masonry dams be founded on bedrock; where bedrock has not been available it has been thought impossible to construct a dam. The Pit River, it appears, is deficient in ideal dam sites, but possesses in other respects such enormous value for power development purposes that our company's engineers have had to solve the problem of dam construction under unfavorable foundation conditions. At the point selected for the Pit Four dam the river bed is of peculiar formation. Bedrock appears practically at the ground surface on the right bank of the river, but from that bank it pitches downward until it drops below the stream to a depth of about fifty feet at the left edge of the river channel. Beyond the left bank its depth increases. With such peculiar formation it was impossible for our engineering department to adopt a uniform type of dam construction for the entire width of the stream.

The problem

was solved in this way. For that portion of the dam which could be founded upon unyielding rock it was decided to construct a gravity type overpour section, while for that portion reaching from the left edge of the main channel to the left abutment, which was to be founded on a relatively yielding formation consisting of compacted soils, gravel and boulders, a flat slab and buttress type of construction was chosen. It may be said, then, that this composite structure, which rises 60 feet above the stream-bed and is 400 feet in length, really consists of two dams, each of about 200 feet in length, placed end to end, the portion at the right bank being built on solid bedrock and of massive dimensions to carry any possible flood waters over its crest, that at the left bank being founded on a reinforced concrete slab laid over a broad, firm earth base, with concrete cut-off walls extending below the stream-bed to intercept possible seepage. Extending from the upstream toe of this slab a heavily reinforced concrete facing is carried up on a slope one-half horizontal to one vertical, receiving support at the rear from concrete buttresses at 18-foot centers. The



View of upstream face of Pit Four dam from near the tunnel intake.

two sections of the dam come together at a heavy division wall founded on solid rock, extending 170 feet up and down stream, 30 feet thick at the base and of 120 feet maximum height. This wall serves as an artificial abutment for the overpour section and as a protective and retaining wall for the river edge of the hollow-type dam.

Unusual consideration was given to such features as aprons, baffle-piers and cut-off walls to safeguard the structure at such times as floods of many thousand cubic feet per second might pass the overpour section of the crest. The downstream toe of this overpour section is protected by a heavy concrete apron extending 100 feet downstream. This is to receive the first shock of the falling water, and to support the concrete baffle-piers against which the energy of the water is dissipated. These piers, 30 feet in height, were designed with great care to insure their faces having precisely the proper bevel to deflect the rushing sheet in the desired direction.

The discharge of water over the 136-foot spillway section is controlled by two huge steel drum gates, each 68 feet long and $14\frac{1}{2}$ feet high. These are raised or lowered by the water pressure. When lowered to their lowest position, the spillways will allow the passage of a flood of 70,000 cubic feet per second, without overtopping the other portions of the structure. When raised they offer an opportunity for storage by lifting the crest of the dam some 14 feet.

Under the massive gravity section of the dam, as well as the lighter slab section, were constructed several deep and heavy cut-off walls whose purpose is to prevent the percolation of water under the dam. At the upstream toe these extend to varying depths, up to 33 feet below the natural stream-bed.

As a further precaution against seepage, 2-inch grout pipes were embedded during construction in the upstream cut-off wall, at 5-foot intervals. After the wall was completed, thin cement grout was forced, under considerable pressure, through these pipes and out into the underlying gravel and boulders, cementing the whole into a solid conglomerated mat.



Close-up view of downstream face of the dam, showing baffle-piers that break the force of the rushing water.

One of the things that is necessary in a dam of relatively light weight, such as the slab and buttress section of the Pit Four structure, is to prevent the upward pressure from the head of the water in the reservoir resulting from chance seepage under the dam. To obviate such pressure what might be termed a pressure relief is installed. This is in the form of open drain tiles which take the water from under the bottom slab and pass it on downstream, thus relieving any pressure tending to be created. Similar provisions were made under the apron of the overpour section to prevent its being lifted.

Preliminary work was started in October, 1925, with the extension of the Pit River railroad from Pit Three power-house one and one-half miles downstream to Pit Four dam site. Also, considerable progress was made in the building of the temporary rock-crib diversion dam and timber flume which were to serve for the unwatering of the river channel at the site of the permanent dam in order to permit the work of excavating the foundations.

The waters were diverted on the first of

May, 1926, and then proceeded the work of excavating the foundations of the permanent dam. Two power shovels were brought into play, and the excavating extended to a depth of fifty feet below the stream-bed. Excavation of the dam required the removal of 70,000 cubic yards of material. By mid-summer of 1926 concrete pouring



Looking upstream from Pit Four diversion dam.

was in progress, practically all the concrete being spouted directly into place from a plant standing high on the right bank of the river. The total amount of concrete poured into the dam totaled 42,000 cubic yards, three-fourths of which went into the heavy overpour section and one-fourth into the reinforced hollow-type section.

Just upstream from the dam, at the right bank of the river, a reinforced concrete intake structure similar to that installed at the head of Pit Three was built at the entrance to the tunnel that, when Pit Four development comes to be completed, will carry the waters across country a distance of $4\frac{1}{2}$ miles to a point above the power-house site on the river bank some seven miles distant from the dam following the tortuous course of the stream.

Pending the completion of the development, Pit Four dam serves to back up the waters of the stream as far as the tail-race of Pit Three power-house and thereby create an afterbay for Pit Three. This is of value in maintaining an even flow of the stream below the power-house in the face of irregular flows from Pit Three forebay due to varying demands upon the generating capacity of the plant. Regulation of stream-flow is a matter of considerable importance, in this region, in order that the supply of river water for irrigating purposes in the downstream territory may not drop below normal.

An interesting public service feature in connection with this recent development is

the construction by our company of a fish hatchery on Burney Creek, below the falls and near the point where the creek empties into Pit Three forebay. This work was undertaken by our company in obedience to the fish and game laws of this State, it being found impracticable to construct a fish ladder at Pit Four dam owing to physical conditions there. The hatchery as constructed is of an estimated capacity of one million fish a year and will supply the Fish and Game Commission with trout to stock Shasta County streams. It is now at point of completion and is waiting to be taken over by the Commission. The State will operate the hatchery at its own expense.

The story of hydro-electric power development by our company in the Pit region to date stretches over a period of ten years. The development had its origin in the purchase by the Pacific Gas and Electric Company, in 1917, of the properties of the Mt. Shasta Power Corporation, whose activities were centered upon a hydro-electric project on Pit River in Shasta County, at a point known as the Big Bend. The extraordinary value of the Pit as a power stream had been recognized by engineers for some time previous. The river itself has its main source in several large underground springs amid the lava beds of Northeastern California at the southern end of the Cascade range. It is distinct from other streams that take their course oceanward in that it rises east of the range, and it is due to the lava formation that its progress is unchecked. In itself it is

a stream of moderate flow capacity, but it gains in volume through the liberal contributions of several important tributaries, notably Fall River, Hat Creek, Burney Creek and Montgomery Creek, so that it acquires a volume reaching some 2,500 cubic feet per second at the point called Big Bend, before referred to, where the last of the chain of Pit River water-power plants is marked for construction. In a country of the peculiar geological formation referred to, the waters of these streams are stored in great reservoirs beneath the surface of the earth, and the result is an even stream flow varying so slightly from season to season and year to year as to be scarcely perceptible.

Such water sources are, of course, ideal for power purposes. The constant flow assures ample water at all seasons of the year without the necessity of constructing large and costly storage reservoirs such as are required in other sections of the State.

Following its first purchase, our company acquired further rights on two of the tributaries of the Pit already mentioned, Hat Creek and Fall River, and the engineering department prepared plans for a chain of power-plants with an aggregate installed capacity of approximately 670,000 horsepower, taking advantage of the drop of 2100 feet from a point on Fall River near its junction with the Pit to the Big Bend, a sixty-mile stretch of river.

Active work was commenced in 1920 upon two moderate sized plants on Hat Creek, not far from that stream's junction with the Pit, and in the fall of the following year these two plants, with a combined generating capacity of 33,512 horsepower, were completed and placed in operation. Then came Pit One, the first of the big chain of projected developments. This was accomplished by diverting the waters of Fall River at a point in Fall River Valley about a mile above the town of Fall River Mills, where that river pours into the Pit, and by means of a tunnel approximately two miles in



The fish-hatchery on Burney Creek, below the falls.

length conveying the water through the intervening hillside to a point in the Pit River canyon 454 feet above the stream, on the bank of which was erected a power-house equipped with electric generating machinery of 93,834 horsepower capacity.

Pit One was completed and placed in operation September 30th, 1922. Almost immediately the engineering department commenced surveys for the next development marked for construction, namely, Pit Three. The main features of this include a 125-foot diversion dam on the Pit River, at a point about ten miles downstream from Pit One, and a four-mile tunnel leading from the dam across country to a point about 300 feet above a power-house erected on Lindsey Flat, six miles distant from the dam following the course of the stream. This development is peculiarly interesting because of its scenic features, particularly the dam, which backs the water of the river into an open reservoir approximately ten miles in length.

Construction work was started in the summer of 1923, and on August 1st, 1925, Pit Three development was placed in service, contributing 108,579 horsepower in generating capacity to the "Pacific Service" power system.

So far, then, hydro-electric development work in the Pit River region has resulted in the completion of installations aggregating 235,925 horsepower.

Lake Fordyce is Now Second Largest Reservoir in System

The work of raising Lake Fordyce, the parent reservoir of our company's Spaulding-Drum system, has been accomplished. By elevating that structure 47 feet the storage capacity of the reservoir has been increased from 20,000 to 46,662 acre feet, making Fordyce the second largest reservoir in the company's system.

The result of this reconstruction work in the higher levels near the Sierra summit will be not only to place at the disposal of our company's electric users approximately 35,000,000 additional kilowatt hours of electric energy, but also—a matter of great importance—to augment the present supply of water for irrigation of the deciduous fruit lands in lower Placer county as well as for domestic use in the various communities of that region.

The additional storage provided by the

parent reservoir will serve to equalize the flow of water through the conduits below the chain of lakes terminating at Lake Spaulding against fluctuations in power demand, and so enable the Bear river canal below Drum powerhouse and the Boardman canal and its tributaries above and below Wise power plant in Auburn ravine to maintain an even flow during the arid months of the year when but for this much needed sustenance the lands under cultivation around Auburn and Newcastle might suffer for want of sufficient irrigation. The extent of deciduous fruit tracts at present benefited by our company's water system in the Sierra Nevada is estimated at 27,000 acres, and a substantial increase of storage facilities in the snow country will help to remove a serious obstacle to agricultural expansion in the valleys below. Not merely



The new Lake Fordyce after its storage capacity had been more than doubled by the raising of the dam.

the present, then but the future is looked to in development work of this kind.

Lake Fordyce is the oldest of a cluster of artificial lakes, twenty-one in number, which are the sources of water supply for our company's Spaulding-Drum system. They lie amid the snow peaks of the Sierra Nevada in the region lying between Summit and Bear valley, and until this recent work of augmentation at Fordyce were of

an aggregate storage capacity of 115,893 acre feet. They formed part of the old South Yuba Water Company's system which was purchased by "Pacific Service" in 1905, and were constructed in early days, together with a series of flumes and ditches, to help out the mining industry in that region and, at the same time to furnish water for irrigation to the counties of Nevada and Placer.

Lake Fordyce is situated on Fordyce creek, a tributary of the south fork of the Yuba river, and is reached by road a distance of about nine miles from Cisco, the nearest point on Lincoln highway and the overland route of the Southern Pacific Railroad. It lies at an elevation of 6294 feet above sea level. It has historical value, for it is located upon what in the pioneer days was known as the Fordyce ranch. The desirability of the site for reservoir purposes was first observed by one Dan Rich, a surveyor of Nevada City, as far back as 1855. The first dam was built there in 1873, and the dam which has just been raised dates back to 1881, though it has been subjected to considerable reconstruction and reinforcement work since that time. It was known as one of the notable hand-placed rock-fill dams built by the California pioneers. Up to the time of its most recent



Spillway on Lake Fordyce, water escaping into Fordyce Creek.

reconstruction it measured about 800 feet in length, 140 feet thick at the foundation and 92 feet high, measuring from the base of the canyon. The reservoir thus created was 20,000 acre feet storage capacity. So it remained through the years until, in 1922, on the heels of a succession of unusually dry winters in the Sierra Nevada, our company's engineers made survey of the Spaulding-Drum system and recommended certain increases in output capacity for the benefit of consumers of both power and water. An important feature of the proposed reconstruction work was the raising of Lake Fordyce dam.

This lake and others in the cluster, nestling amid the snow peaks far from the beaten path, furnish eloquent testimony to the energy and resourcefulness of the pioneers who built them. Take Lake Fordyce as an example for upwards of fifty years since the first dam was constructed the only way in was by mule trail over the hills from Cisco. It must be remembered that the original dam was constructed when hand labor was quite economical; consequently, construction work and subsequent improvements were adequately effected by sending in supplies by pack train from Cisco, while equipment was hauled from Truckee by way of Webber lake to the upper end of

Fordyce and barged down the lake. But in this last job, with the great advantage of utilizing mechanical equipment to the fullest extent, to say nothing of large amounts of cement and other construction material, the first requirement for preliminary work was a road over which heavy loads could be hauled by modern transportation equipment. This was done, and today the visiting automobile rolls over a good mountain road, with about a twelve per cent maximum grade.

The equipment at the lake for construction purposes consisted of a cement store house, where as much as 15,000 sacks found lodgment at one time, a mixing plant close by, a rock crushing plant and the usual warehouse, machine and blacksmith shops. Two shovels, one 70-ton steam shovel and one 40-ton air shovel, were used at the dam site, while three dinkey locomotives delivered rock from the quarry to the dam. Two 25-ton locomotives did the hoisting. Everything was standard gauge, including the two locomotives, fourteen dump cars and six flat cars. Five derricks were used to take the rock from the cars and place it on the rubble section of the dam on the upstream side.

Rock for the dam was blasted out of a neighboring hillside. One blast was furnished by sixteen tons of black powder which let loose 30,000 cubic yards of rock, one-tenth of the total amount required, at one upheaval. Cement was shipped to the lake from Cisco. Sand was obtained from the mouth of Bloody Run creek, as the miners called it, Sterling creek as it appears on the map. The miners called it Bloody Run because in the original settlement a slaughter house was located there.

The company's offices and buildings were placed on the highway about one-half mile from the lake. These included mess house, cooking house, recreation hall, eight bunk houses and a number of tents and platforms. The compressor-house close by contained four large compressors, of a capacity of 3,500 cubic feet of air per minute.

Electricity was delivered at the plant from a substation a quarter of a mile away connected by a transmission line which tapped the 60,000 volt line from Spaulding to Summit.

The road into Fordyce winds up the side of Red Mountain and crosses at an eleva-



A glimpse at historical Lake Fordyce from the Cisco highway crossing Red Mountain.

tion of 7,200 feet. Above this point, at the top of Signal peak, is the Southern Pacific Lookout Station at an elevation of over 8,000 feet. From this road the eye, looking northward and eastward, takes in a great vista of historical country. Looking to the eastward from Fordyce there is a ridge which separates the Truckee river watershed from that of the South Yuba. Independence, Webber and Donner lakes are the principal bodies of water on the Truckee river side, while Meadow and Fordyce lakes are fed by Fordyce creek. Another ridge to the northward separates the South Yuba from the middle Yuba watershed.

Meadow lake lies two miles to the north of Fordyce. The old stage route from Virginia City crosses the ridge from the northeast. It was at one time the site of a thriving community. That was in the early mining days. Today, when the lake is dry, one may observe the ground strewn with relics that have never been moved since the miners decamped. There are bottles, pieces of old stoves and all sorts of things that were part of the domestic equipment in that locality. It is hard to realize that upwards of half a century has elapsed since they were in use.

Even to this day the mining camps on that historic spot are active, in that a great many claim owners have held their rights and kept their claims alive each year by doing a sufficient amount of work to hold them against forfeiture. These claims run 1500 feet in one direction by 600 in another.

One has fairly embarked upon the lake region in that locality. Lake Stirling lies upon the creek of that name, a tributary of Fordyce creek, White Rock above Fordyce. Fuller, Rucker, Blue Lake, Colverson, Upper and Lower Lindsay form a cluster to the northwest of Lake Spaulding and by way of Texas creek empty into it.

Lake Spaulding is the controlling reservoir of the Spaulding-Drum system. The first dam was built there in 1892, but this was obliterated thirty years later when our



Section of reconstructed Drum canal, showing metal flume.

company built the present 275-foot structure in the South Yuba gorge that transformed Spaulding from a comparatively modest body of water into a reservoir of 74,488 acre feet capacity. The water escaping from Fordyce travels westward about ten miles to a point where Fordyce creek empties into the upper end of Lake Spaulding. It passes through Spaulding into Drum canal and thence on a distance of nine miles to Drum power plant in Bear river gorge, a drop of 1375 feet. After turning the wheels of Drum power house the water is released into Drum afterbay and thence down Bear river to the intake of Bear river canal near Colfax. It travels down valley and on its way passes through Halsey power house in Christian valley near Clipper Gap, then on to Auburn where it serves to operate Wise power house in Auburn ravine. From that point the water is distributed for irrigation purposes as far west as Roseville.

In connection with this and other projects in contemplation in the Sierra Nevada region there has been considerable work done in improving and enlarging Drum canal. A second penstock has been laid down the slope leading from Drum forebay to the power house, a fourth generating unit is being installed in Drum, and below the power house there has been constructed an afterbay with a dam 100 feet in height, designed to equalize the flow of water down Bear river against fluctuations in demand upon the power plant.

The Story of Power in California

By A. H. MARKWART

(Resume of an address before the Franklin Institute of the State of Pennsylvania Philadelphia April 20th, 1927)

The old saying, "Coming events cast their shadows before," is peculiarly applicable in the story of hydro-electric power in California. Few, even of those who live in this State, realize that the discovery of gold, an epochal event, while of direct political and economic importance at the time and subsequently, was but the precursor of even greater things. Gold mining has always had a fascination for Californians and, according to tradition, the Spanish explorers themselves, inspired by the romance, "Las Sergas de Esplandian," by Montalvo, published in Spain in 1510, considered that the "California" of this romance, where gold and precious stones were found in abundance, was that unknown country north of Mexico.

Curiously enough, the hydraulic monitor, operated with water from the early ditch systems, which mined the auriferous deposits, and the hurdy-gurdy, logically following, which permitted deep mining on the original veins of the Sierra Nevada, fore-shadowed the general use of the power of falling water. They were harbingers of the widespread power supply which has contributed so largely in bringing California into the industrial field. While the portent and effect of events in the electric power industry are more significant than dates, the story will nevertheless be enriched if a brief chronology of some years of critical occurrence is given.

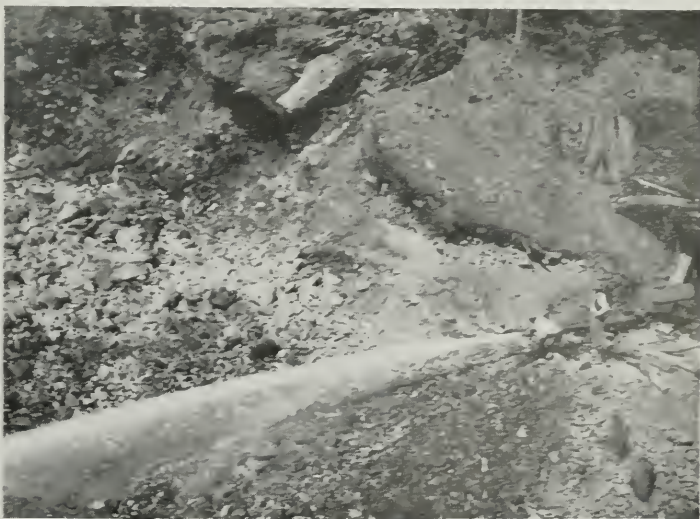
John Marshall discovered free gold in 1848 at Coloma on the South Fork of the American River.

In 1852 Edward E. Mattison, a Connecticut Yankee, with a view to economizing labor, used a stream of water under pressure with his invention of the monitor.

Gold quartz veins were discovered in 1851 and the use of the hurdy-gurdy, the offspring of the monitor, followed in due course. Starting about 1866, modifications of the hurdy-gurdy were introduced for the purpose of improving the efficiency or increasing the output.

The first noteworthy experiments on hurdy-gurdy wheels were conducted by Hamilton Smith, Jr., about 1875.

Although J. B. Francis of Lowell, Massachusetts, invented the Francis type of reaction water turbine for low and medium heads in 1849, this type of wheel was not employed in water-power practice in California until many years later, on account of the early practical development there of the



A precursor of hydro-electric power—monitor used for hydraulic sluicing in mining operations.

impulse wheel where conditions for the development of water-power made such a wheel necessary. It was better adapted for use under the high heads which had been produced for the purpose of hydraulicking the gold-bearing gravels, and made available more readily and immediately the motive power that was essential to the conduct of quartz mining.

The use of water-power was greatly facilitated through the development by Lester Pelton, in 1880, of the Pelton type of bucket for use on improved impulse wheels. This development made possible efficiencies that were not obtainable with the crude hurdy-gurdy, and was the first step in placing the impulse wheel in the position it now holds as an efficient prime mover.

Coupled chronologically with the mechanical improvement of the water wheel as a prime mover were two other factors which created a triad that was to render feasible the extensive development of hydro-electric power in California. One was the establishment in 1879 of a small central station in San Francisco, furnishing a limited steam electric service, which germinated the demand for electric energy and its compounding growth which we see today. The other factor was the demonstration by Italian engineers, in 1886, that electric current could be sent through a wire a distance of 17 miles to Rome, from their steam plant at Cerchi. Thus came into being the means of connecting the water power lying potentially in the mountain reservoirs and along ditches of the miners with the power load in the cities.

The co-ordination of these factors, — a water power to serve a distant demand through the agency of a transmission—was secured, for the first time in the world, in Oregon in 1889, when a hydro plant at Oregon City transmitted single-phase power at 4 kv. a distance of 13 miles to Portland.

This was followed two years later by a 10-kv. single-phase transmission $28\frac{3}{4}$ miles in length from the Pomona plant to San Bernardino. This was the first hydro-electric development in California.

The next decade saw a steady increase in transmission voltages and distances both in northern and southern California, together with the first 3-phase installation of any considerable size, the 3,000-kw. plant at Folsom on the American River.

Of great importance in this progression was the first 60-kv. transmission accomplished by the Bay Counties Power Com-



The mining flumes of early days suggested the present day hydro-electric conduit.

pany in 1901 between Colgate and Oakland, a distance of 142 miles, in that its success inspired similar ventures at higher voltages, throughout the country, notably in California, Michigan and Colorado. In 1909 the Great Western Power Company of California completed its 154-mile 110-kv. line from Las Plumas to the San Francisco bay region. By 1913 a 150-kv. system of 241 miles had been constructed by the Pacific Light and Power Corporation (subsequently merged with the Southern California Edison Company) from its Big Creek Plant to Los Angeles.

Ten years passed before transmission voltage was raised from 150 kv. to 220 kv. This took place in both northern and southern California in 1923. The Southern California Edison Company accomplished it by reconstructing its 150-kv. system for 220-kv. operation, and the Pacific Gas and Electric Company by building its Pit transmission line from the Pit River to the Vaca-Dixon substation, a distance of 202 miles.

The first modern high pressure, high temperature, steam turbine plant installed on the Pacific Coast was completed in Los Angeles by the Southern California Edison Company in 1924, this installation being largely inspired by the deficiency in precipitation during the 1923-24 season. This plant, consisting of two units of a rated capacity of 35,000 kv-a. each, operates with about one-half the fuel consumption of the average Pacific Coast plant, the steam plant performance of plants then existing and still functioning being to the order of 30,000 B. t. u. per kilowatt-hour.

While gold mining cradled power development in northern California, it was not only mining and its water-power phases that started the regional power system off on a hydro-electric basis. Steam power for direct drive was also employed at the mines, and the centers of population had steam electric power before the advent of hydro-electricity. Only within the last few months one of the most important of the Mother Lode mines, the Kennedy Mine at Jackson, Amador County, the deepest vertical-shaft gold mine in the United States, which had clung to the use of steam power, discarded it in favor of electric service. In the early days steam plants, to burn wood fuel, were installed for the hoisting of ore and the running of stamp-mills. The fuel problem was a serious one, as tremendous quantities of cordwood had to be transported and stored during the summer months. Obviously there was no economy in fuel consumption. In the cities coal prices ranged from \$4 to \$11 per ton, depending upon the point of delivery, whether at tidewater or inland, and fuel oil



Old mining ditch now used to carry water for power generation.

had just come in. Fuel economy, judged by present standards, was very low, being to the order of 100,000 to 50,000 B. t. u. per kilowatt-hour. The service of the steam plants which were in existence in every principal city of the State by 1886 was, accordingly, for economic reasons, confined to the narrow limits of the city distribution systems. Under these power conditions hydro-electric power was a natural result.

During the decade of 1890 to 1900 hydro-electric development commenced almost simultaneously in northern and southern California, and both sections of the State have steadily progressed with the building of their general power systems. It was perhaps the presence of the miners' ditches on the Sierra streams from the Yuba to the Merced, and the primitive steam plant practice in the cities, and at mines where steam power was employed, which prompted hydro-



Folsom power-house, on the American River, the "daddy" of hydro-electric transmission in northern California. Built in 1895.

electric development in northern California. On the other hand, the desire to furnish power to manufacturing industries at a price equivalent to that in localities where coal was \$4 per ton, brought it about in southern California. A system of miners' ditches was the nucleus of the Pacific Gas and Electric Company in northern California, and \$11 coal at Redlands in 1892 accounts for the Southern California Edison Company in southern California. The Great Western Power Company in northern California had an early but unconscious beginning when the 2½-mile tunnel was cut across the Big Bend of the North Fork of the Feather River by the miners to permit the working of the free gold which was suspected to lie in the river bed. The tunnel is now used for the generation of electric power.

Some of the early day plants still exist, notably the Folsom plant of the Pacific Gas and Electric Company, which was built to supply the city of Sacramento, and the Mill Creek No. 1 plant of the Southern California Edison Company built to supply the city of Redlands. Each of these plants was the result of the then extremely poor steam-plant performance and relatively high-priced fuel. However, a number of other plants in northern California were built to



Rome power-house, on the South Yuba River, built in 1896, furnished power to the mines of the Nevada City-Grass Valley region.

displace the water or steam power at the mines, and soon after the mines had received electric power, the nearby towns, which had their birth in early mining days, and the agricultural areas surrounding them, were connected to the promising young hydro-electric systems which had sprung up here and there by 1898.

Along in 1899 the Colgate plant on the North Fork of the Yuba came into the picture. It was an ambitious undertaking, brought about by the success obtained with the smaller Ne-



Colgate power-house, historical for the first inauguration of long-distance transmission at 60,000 volts.

vada plant on the South Fork of the Yuba River, and the Yuba plant which took water from an old mining ditch that had its diversion on the North Fork of the same river.

In 1898, because of a shortage of water at Folsom, the idea of connecting two remote power supplies was conceived. In the following year Sacramento, which had a steam plant, received power from the Colgate-Folsom interconnected power system. This proved later to be an occurrence of tremendous importance, for such a tying together of hydro-electric plants and a steam plant to supply light to cities and to serve industry and agriculture with power, established the principles: first: that advantage could be taken of the diversity which exists in stream flow; second: that a steam reserve furnished the desired continuity to hydro-electric service; third: that pooling of a regional demand, which varied daily, seasonally, geographically and with the character of energy usage, resulted in economy, owing to the greater number of hours which a given plant capacity could be effectively operated.

Following the notable transmission feat of the Bay Counties Power Company, its Colgate-Oakland line, the system of the Standard Electric Company was brought into service in 1903. As the name of the forerunner company implies, the rich load center about San Francisco bay was the real objective of both. The Electra plant of the latter company in the mining region on the Mokelumne River was connected by a 60-kv. transmission line to San Francisco bay region by way of Stockton and San Jose, and to the Colgate plant by means of a branch



A typical high-tension transmission tower in the snow country.

line to Oakland. Aside from the importance of these lines, as forward steps in transmission practice, the interconnection of these companies at Oakland stimulated the interconnection idea previously developed in a smaller way at Sacramento.

These physically connected plants fur-



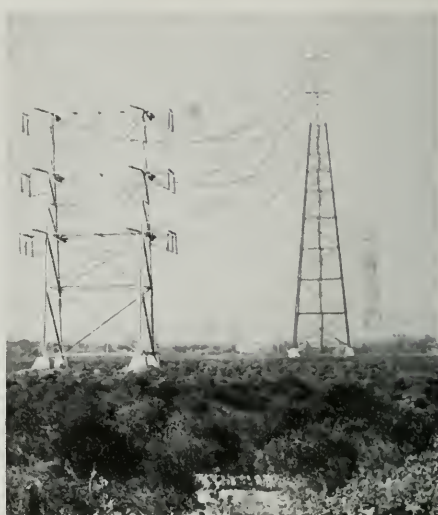
Vaca-Dixon substation, a 220,000-volt terminal for the distribution of power from the Pit River.

nished the nucleus of the great consolidated hydro-electric, steam-supported power systems which now give California its universal power supply; and this early acquisition of diversified markets for the infant central station industry ushered in the high system load factors which prevail in California today.

It was but natural that consolidation of companies took place in due course, the Pacific Gas and Electric Company of northern California being a notable example. It is not the intention to review the history of the growth of the power companies of California. Suffice it to say that southern California had a similar power system growth, the Southern California Edison Company, serving Los Angeles and cities clustering thereabout, being the outcome of the pioneer plants on Mill Creek.

The 60-kv. transmission which generally prevailed at the time the original power pool was started could be tapped en route because this voltage permitted substation costs which bore a proper economic relation to the size of the loads to be carried. The significance of this probably was not realized at the time, but in a measure this economically suitable voltage made it possible for industry to locate in rural communities, and is responsible to some extent for their growth.

It safely may be asserted that if, along in 1895, the art of steam-electric power gener-



Sacramento River crossing of the Pacific Gas and Electric Company's 220,000-volt line. The center tower is 459 feet high, believed to be the highest transmission tower in the world.

ation had been advanced 30 years, steam plants would have prevailed and a power supply for rural territory would have been long delayed. So, it was fortunate that California engaged in hydro-electric enterprise, that the power sources were so situated

that the rich interior valleys had to be traversed with transmission lines to connect these sources with the major markets on the coast, and that the high voltage possible for transmission with the then state of the art was as low as 60 kv.

Economic Phases

A load having been built up in the cities on steam-electric plants, the general utilization of water power became possible when it appeared



Lake Spaulding, a typical storage reservoir in the high Sierras. Capacity, 75,000 acre-feet.

to enterprising groups that there was present an opportunity to profit by shutting down the steam plants and substituting hydro plants. This substitution was facilitated by the ease with which undeveloped water power sites were to be obtained at that time.

These early promoters, speculators in power as they were, doubtless did not realize that they were starting an industry which was destined to exert a benign effect on the industrial, agricultural, and domestic life of times which were to follow. Since then the character of the enterprise has changed, speculation has given way to industrial leadership and central station service has developed beyond fondest expectations. Power lines have multiplied, and the capital concentrated in the electrical utilities is employed at low wages, with the result that energy is available almost everywhere at a price which permits general industry, small or large, to locate wherever raw materials, labor and transportation are available and allows it to devote the great bulk of its resources to its own direct expansion. Thus, manufacturing has been added to mining; dry farming of vast acreages in grain has been displaced by intensive cultivation of smaller holdings with irrigation; payrolls have grown in number and amount; and economic diversity for the State has been the by and large result.

The public utilities of California have a keen appreciation of the idea that they have duties as well as privileges. While they have thrived under private ownership there has been due regard for the interests of the consuming public. The control, which is largely Californian in its desire to create condi-

tions favorable to general industry and pleasant living in a State not yet fully developed, may have something to do with this. Or, a greater degree of public regulation and socialization may tend to prevail here than elsewhere. Perhaps this causes the industry to proceed rationally along the lines of least resistance, recognizing that success in the long run will be had by agreeing with rather than opposing public sentiment, as far as this is possible without destroying the individualism which has placed the industry where it is today and which must be retained to furnish the personal and vital interest which is essential if the industry is not to be quiescent. Whether the actuating motive of the industry which flowered from a desire within is called altruism or enlightened selfishness is of no moment, for "that which we call a rose, by any other name would smell as sweet." All that the electrical industry of California receives is a financial return sufficient to maintain itself in that economic position which will permit an expansion sufficient to meet the needs of the growing State. The industry is fully aware that the rate at which it can sell energy will go down as the use per average consumer goes up.

(To be concluded in our October issue.)



Drum power-house on Bear River. A typical high-head plant. Head, 1375 feet.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the first six months of the current year. The increases in each item of revenue and expense compared with the corresponding period of 1926 are also shown.

CONSOLIDATED INCOME ACCOUNT		INCREASE	
	6 Mos. ENDED JUNE 30, 1927	OVER 1ST 6 Mos. 1926	
Gross Revenue, including Miscellaneous Income.....	\$27,711,895	\$2,554,629	
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals and Reserves for Casualties and Uncollectible Accounts.....	15,292,672	176,795	
Net Income	\$12,419,223	\$2,377,834	
Bond Interest and Discount	4,771,159	656,739	
Balance	\$ 7,648,064	\$1,721,095	
Renewals and Replacements Reserve	2,461,133	239,751	
Surplus	\$ 5,186,931	\$1,481,344	

The increase in gross of \$2,554,629, or 10.2%, is somewhat better than normal, due to intensified sales activities for the disposition of a large volume of additional energy derived from new hydro-electric installations on the Pit River and from other sources. The increase in net reflects in a large degree the return on the substantial amount of new capital invested in these Pit River installations and in additional distribution facilities.

As a final result of the six months' operations, there remained, after the deduction of dividends accrued on all preferred and common stock, a balance of \$893,795; earnings available for common representing 5.55% upon the average common stock outstanding during this period.

ACQUISITION OF ADDITIONAL PROPERTIES

An important addition was made to the Company's system through the recent purchase from the Standard Gas and Electric Company of its entire and controlling interest in several California public utilities; namely, Western States Gas and Electric Company of California, Sierra and San Francisco Power Company, Coast Valleys Gas and Electric Company, Del Monte Light and Power Company and El Dorado Power Company. The entire capital stock of the latter Company is owned by the Western States Gas and Electric Company of California, the latter being controlled by the Western States Gas and Electric Company of Delaware, which was also sold to the Pacific Gas and Electric Company. In all, a total of \$27,029,700 par value of stocks was acquired by the Pacific Gas and Electric Company, as follows:

- \$20,000,000 par value, being all of the issued and outstanding capital stock of the Sierra and San Francisco Power Company.
- 3,000,000 par value of the common stock of the Coast Valleys Gas and Electric Company, representing the entire issue.
- 751,500 par value of the common stock of the Western States Gas and Electric Company of California.
- 3,253,200 par value of the common stock of the Western States Gas and Electric Company of Delaware.
- 25 000 par value, being the entire outstanding stock of the Del Monte Light and Power Company.

The contract with Standard Gas and Electric Company also provides for the purchase by the Pacific Company of certain power projects on the Feather River, California, capable of developing approximately 350,000 h.p. of hydro electric energy, on which about \$500,000 has been expended to date.

In consideration of the transfer of the stocks and properties above enumerated, the Pacific Gas and Electric Company issued to the Standard Gas and Electric Company \$6,500,000 par value of its common stock (constituting approximately 5% of this Company's total outstanding stock) and also paid \$2,085,000 in cash. A brief description of the more important of the acquired properties may be found in the editorial columns of this issue.

All of the newly acquired properties are contiguous to the territory served by the Pacific Gas and Electric Company; are interconnected with the latter, and purchase from it a large volume of power for re-distribution; and, except to a very slight degree, occupy business fields that are neither overlapping nor competitive. Control of these properties, involving practically no duplication of facilities, constitutes, therefore, a logical and economically sound extension of the Pacific Company's activities. The acquired companies will, for purposes of operation, become virtually a part of the Pacific Company's system and large economies in operation and administration, and the development of considerable additional business is anticipated from this direct and unified management. The combined properties will serve approximately 950,000 customers over a network of 16,300 miles of electric transmission and distribution lines and 4,800 miles of gas mains. Installed hydro-electric capacity will exceed 807,000 h.p. and total connected load, 1,855,000 h.p. Combined operating revenues are in excess of \$57,000,000 per annum.

A summarized statement of essential statistics of the acquired properties follows:

	SIERRA	WESTERN STATES	COAST VALLEYS	TOTAL ACQUIRED COMPANIES
Gross Revenue, 12 mos. ended March 31, 1927	\$2,969,716	\$3,455,691	\$1,294,214	\$7,719,621
K.W.H. Sales	57,241,268	99,865,325	38,451,197	195,557,790
Gas Sales (Cu. Ft.)	—	581,305,000	141,888,000	723,193,000
No. of Customers (March 31)				
Gas	—	15,498	4,708	20,206
Electric	8,997	40,020	10,804	59,821
Water	1,556	—	2,007	3,563
Total Customers	10,553	55,518	17,519	83,590
Connected Load (H.P.)	138,549	149,571	54,174	342,294
Installed Generating Capacity (H.P.)	94,336	77,613	2,466	174,415

Under the terms of purchase agreement the operation of these subsidiary companies was assumed by the Pacific Gas and Electric Company on May 1, 1927, subject to the approval of the State Railroad Commission. The Commission's authority was subsequently secured under Order No. 18567, dated June 30, 1927.

The properties, of which the entire or the controlling stock interest is thus acquired include physical properties appraised at more than \$60,000,000, approximately 450,000 h.p. of undeveloped hydro electric situations, and other values, including an established business exceeding \$7,700,000 annually derived from services to more than 83,000 customers.

"PACIFIC SERVICE" TO PAY OFF OLD MORTGAGE

On the first day of November next the oldest mortgage executed by any of the Pacific Gas and Electric Company's predecessors in connection with its water power developments will fall due. It was executed in 1897, and was designed to secure bonds issued to refund the bonds that had previously been issued by the Folsom Water Power Company, the Sacramento Electric Power and Light Company, and the Central Electric Railway Company, these companies having effected a consolidation under the name of Sacramento Electric, Gas and Railway Company. It was not, therefore, the first water-power mortgage, but as it actually replaced the first one and, as a practical matter, continued it, we may regard it as the basic security for the first bonds issued in America to finance a water-power development. There were other hydro-electric power plants in operation

before the Folsom power house was completed, but these were financed without bond issues.

The bonds authorized under this mortgage amounted to \$2,500,000, but as the Central Electric Railway bonds were never refunded the total issue was \$2,235,000. This does not impress one as a very large figure in these days of superfinance, but at the time this mortgage was executed it was regarded as a notable transaction. Folsom powerhouse was the initial development of America's first great regional power system, and was also the first instance of financing water power development by bond issues. This plant is, therefore, a landmark in industrial development, in electrical progress and in financial history.

As every interest coupon has been paid promptly on presentation, and as every obligation of the mortgage has been promptly met, and as the remaining bonds will be paid in full in cash at maturity, November 1, 1927 will witness the honorable conclusion of a very important and creditable financial transaction.

The payment of a mortgage is often a notable event, particularly with individuals; but Pacific Gas and Electric Company has had so many of these that the experience is not particularly thrilling unless, as in the present case, it is associated with historical events of unusual importance. At the organization of the Pacific Gas and Electric Company in 1905 the properties it acquired were pledged under various mortgages and trust deeds to secure twenty-three different bond issues. Ten of these issues have since been paid in full and retired. Eight others will fall due within the next five years. In the acquisition of its various properties since 1905 the Pacific Gas and Electric Company has executed three mortgages and has assumed the responsibility for fifteen others, of which four have been paid in full, leaving fourteen still in effect, of which four will mature before the end of 1932. This makes a total of forty-one separate and distinct mortgages that the Pacific Gas and Electric Company has dealt with during the twenty-two years of its existence, and having paid fourteen, both principal and interest, we look forward to the maturity of the other twenty-seven with confidence that they, too, will be promptly and fully paid at maturity.

The financial figures represented by these transactions are as impressive as the number of the security issues involved. The twenty-three mortgages in effect on Dec. 31, 1905, secured indebtedness amounting to a total of \$49,452,992. Ten of these bond issues, amounting to \$18,175,992 have been paid off and cancelled, and \$16,877,100 paid on the other thirteen issues, leaving only \$14,399,900 of the original debt still unpaid. Of the fifteen bond issues assumed by the company in the purchase of other properties since 1905, amounting to a total of \$11,589,800, four, amounting to \$716,400, have been paid in full, and \$2,457,500 paid on the remaining issues. Under the three mortgages executed by the company since its organization, bonds with a par value of \$153,120,000 have been issued, on which \$5,726,000 has been paid to Dec. 31, 1926. Summarized in another way, these payments were as follows:

	No.	AMOUNT
Bond Issues of Predecessor Companies Paid Off in Full. and		
Cancelled	12	\$ 4,566,400
Reduced by partial payments.....		19,334,600
P. G. & E. Bond Issues Paid Off in Full and Cancelled.....	2	14,325,992
Reduced by Partial Payments		5,726,000
Total		\$43,952,992

But the most gratifying consideration, to the company at least, in connection with these transactions is that in nearly every instance the most important elements of the properties created through the expenditure of the funds obtained from these old bond issues remain intact, and are still serving the public efficiently and well, and still earning an income. This is especially true of such properties as those of the South Yuba Water Company, which is the foundation of our Spaulding Drum-Halsey-Wise chain of power plants, the Central California Electric Company, which is still represented by Alta power house and the Alta-Sacramento transmission line, the Central Electric Railway Company, still in service in Sacramento, and the Oakland Gas, Light and Heat Company, which

still serves the great East Bay territory. In some instances, the original property has been replaced by more modern structures and installations, but in each instance of that kind the cost of the reconstruction or replacement has been partially paid for from reserves set aside from the earnings of the original property, and the investment has been kept intact.

And, when the last of the Sacramento Electric, Gas and Railway Company's bonds are paid next fall, the Folsom power house will remain and will continue to be maintained as an important unit in the great water power system that has contributed so vastly and so vitally to the development and prosperity of California.

DISTRIBUTION OF OWNERSHIP OF GAS AND ELECTRIC COMPANIES IN CALIFORNIA

The Pacific Gas and Electric Company has recently completed a canvass of the distribution of ownership of the stock of California gas and electric companies. Statistics secured from the twelve largest utilities in the State furnishing these services to the public show that the stock of these twelve companies alone is held by 207,884 individuals, of whom 183,940, or 88.5% are California residents. Only 23,944 stockholders, or 11.5% of the total, are non-residents of the State.

The preferred stocks of these companies are especially popular in California, 146,072 individuals, or 92% of all preferred stockholders, being local residents, with average holdings of fifteen shares (of \$100 par value) per stockholder.

In local ownership, the Pacific Gas and Electric Company heads the list with \$92,352,900 par value of its stock held in this State, exclusive of approximately \$2,500,000 worth of stock, which is being subscribed for by some 3,500 of the Company's employees on the installment plan. Practically three-fourths of this Company's entire issued and subscribed stock is owned by California people.

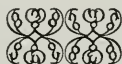
The stocks and bonds of public utilities seem to be particularly popular with the fair sex as a medium of investment. No less than 19,439, or 41.3% of the Company's 47,043 stockholders, are women, with \$38,071,225 par value of stock standing in their own names. In addition, our stock registers include 6,659 joint tenancies. These, in the great majority of instances, represent joint ownership by husband and wife.

A brief summary classifying this Company's stockholders as between men, women, joint tenancies, associations, etc., follows:

CLASSIFICATION OF PACIFIC GAS AND ELECTRIC COMPANY'S STOCKHOLDERS, JUNE 30, 1927

	NUMBER OF STOCKHOLDERS	PER CENT OF TOTAL
Men	20,078	42.7%
Women	19,439	41.3%
Joint Tenants	6,659	14.2%
Associations, Insurance Companies and other institutions.....	867	1.8%
Total.....	47,043	100.0%

It is an interesting commentary upon the extent to which the people of this State have invested their savings in the securities of local utilities to observe that they hold \$241,726,400 par value of the capital stock of the twelve utilities to which reference has been made. This, by way of illustration, is a greater amount than the entire aggregate of savings bank deposits in such states as Indiana or Iowa. Even these figures tell only a part of the story, as they are exclusive of many millions of dollars' worth of bonds of these companies, which are held by California investors.



Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE

PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY

245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII

JULY, 1927

No. 1

Readers of PACIFIC SERVICE MAGAZINE will be interested to learn that the California State Railroad Commission has approved the acquisition by our company, through purchase from the Byllesby interests of Chicago, of the Sierra and San Francisco Power Company, the Western States Gas and Electric Company and the Coast Valleys Gas and Electric Company, all three public utilities operating in central California.

"Pacific Service" has already assumed the management and operation of the properties of these companies.

The Sierra and San Francisco Company's operations extend over ten counties of California, including San Francisco. The company serves electric consumers in the upper San Joaquin Valley, particularly in the counties of San Joaquin and Stanislaus. In San Francisco it serves power to the Market Street Railway Company's system under an exclusive contract running until 1953, and from a substation in Visitacion Valley it maintains high-tension power transmission lines running down the San Francisco peninsula south as far as Salinas. In the way of hydro-electric generating facilities the company's properties include three water-power plants on the Stanislaus River and tributaries, named, respectively, Stanislaus, Phoenix and Spring Gap, of an aggregate installed capacity of 58,143 horsepower. In San Francisco it owns and operates a steam-electric generating station at North Beach, of 36,193 horsepower capacity, which is used as a stand-by plant to safeguard service against interruptions on the transmission line. From the operating standpoint, the acquisition of this company is no new thing, for its properties have been operated by "Pacific Service" under lease since January, 1920.

The Western States Gas and Electric Company serves electric consumers in eight counties of California. It controls electric service in the city of Stockton, and from that point northward as far as Sacramento this territory, as well as portions of El Dorado, Calaveras and Amador Counties, is served from hydro-electric plants on the American River. One of these, the American River plant, situated about six miles above the historic town of Placerville, is rated at 7,540 horsepower capacity; the El Dorado plant, located twenty-one miles above Placerville, is rated at 33,510 horsepower. The latter is a comparatively new plant, for it dates from January, 1924; and it is said of this that it is capable of ultimate development to an installed capacity of 80,000 horsepower. The company maintains a steam-electric plant in the city of Stockton, holding this in reserve to carry load during dry seasons. This company also controls the electric distributing system in the city of Richmond, Contra Costa County. Then, taking a jump northward, the Western States owns and operates a water-power plant on the Trinity River, Humboldt County, of 3,350 horsepower capacity, and a steam-electric plant of 10,890 horsepower capacity in the city of Eureka.

In the way of gas service, the Western States operates in the cities of Stockton and Eureka. Its generating plant in Stockton is of 3,612,702 cubic feet daily capacity and that in Eureka of 500,000 cubic feet daily capacity.

The Coast Valleys Gas and Electric Company owns and operates small steam-electric plants in the cities of Salinas, Monterey and King City. From Salinas south as far as San Ardo it operates a transmission system, and for the purpose of supplying customers in the territory named it has been purchasing power from the Sierra and San Francisco system. The Coast Valleys controls gas service in Monterey and Salinas, operating a generating plant in each of those cities and distributing gas in Pacific Grove from the first named. It also owns and operates the domestic water distribution systems in Salinas and King City.

These new additions to the Pacific Gas and Electric comprehensive system have brought about the creation of two new territorial divisions. The first of these, Humboldt Division, comprises the territory now served by the Eureka division of the West-

ern States Gas and Electric Company, and Mr. H. L. Jackman has been appointed manager of the division with headquarters at Eureka. The other is the Coast Valleys division, with Mr. James F. Pollard as division manager with headquarters at Salinas.

The Stockton properties of the Western States and the transmission and distributing systems as far north as the Consumnes River will be operated by the present San Joaquin Division. Mr. Charles S. Northcutt, manager of the division, has moved his headquarters from Modesto to Stockton.

Hydro-electric plants on the American River belonging to the Western States system, with their transmission and distributing systems as far south as the Consumnes River, will be operated by Sacramento Division. That division will also handle the electric distribution systems in Placerville and elsewhere in El Dorado County.

The electric system in the city of Richmond and suburbs will be operated by East Bay Division.

Acquisition of the Sierra and San Francisco Power Company will involve no change in the operation of its properties.

The value to "Pacific Service" of the acquisition of these properties may be gathered from a statement issued by our company's president, Mr. Wigginton E. Creed, at the time the application for permission to purchase was filed with the State Railroad Commission. Said Mr. Creed: "The merger of these important Byllesby properties under the control and management of the Pacific Gas and Electric Company is both a logical and constructive move in the future development of the electric power service of Northern and Central California. The territories served by the three merged companies are immediately adjacent to that of the Pacific Gas and Electric Company and, in some instances, extend within the exterior boundaries of the Pacific Gas and Electric Company. All three companies are substantially interconnected with the Pacific Gas and Electric system and their addition to the latter involves no more than the absorption of contiguous territory and the operation and development under one management of companies already economically and physically joined with the Pacific Gas and Electric Company.

"Both seller and buyer were moved to consummate the transaction because of its resultant advantages in the rendition of low-

cost electric service and the added effectiveness possible in the management of the properties under unified direction."

It has been suggested more than once in these columns that any fair-minded citizen entertaining misgivings as to the sincerity as well as efficiency of the public service as conducted today under so-called private ownership, would do well to attend a convention of leading lights of any particular branch of the public service in which he is interested.

He would find himself amid a gathering of men of serious mind and purpose, assembled to seriously consider every phase of the particular industry in which they are engaged, and with *service*, always *service*, as the key-note of their deliberations. Public policy is the reigning theme of discussion at the general sessions, and to discuss public policy means to discuss service to the consumer. There are big men in the electric industry today, and they think and do big things in a big way. The bigger the man the better he knows that he is a public servant and that his business is to serve and not to rule the public.

The Pacific Coast Electrical Association recently held its annual convention at Santa Cruz. Several hundred delegates came from all parts of the Coast and to these were added prominent leaders in other walks of life as guests. This convention comes upon the heels of the annual gathering of the parent body, the National Electric Light Association, held usually in the East, and it has become an established custom for the newly elected president of the parent body to make the journey across the continent in order to be present at the councils of the electrical industry in a section of the country that not only leads the world in hydro-electric development but is first in the per capita consumption of electric energy.

It was interesting to hear Mr. H. T. Sands of New York, the new president of the N. E. L. A., at the Santa Cruz convention. He gave sound business counsel when he advised his hearers to spread the gospel of electricity in the home; he gave the lie to the public agitator against rates for service when he showed how as against a general advance in the cost of living since the world war the price of electricity had been reduced ten to fifteen per cent below pre-war figures; he spoke for the public good when he

said: "Intelligent public opinion is the best possible defense against political attack; but, don't base it on misinformation or half information, or it may become a serious liability." He paid his respects to public ownership, so-called, and gave the lay mind something to think about when he asked: "Who would pay the \$150,000,000 annual taxes paid by the corporations today if the United States Government were to take over the public service?"

Mr. Sands illumined his address with quotations from Presidents of the United States at opposite ends of history. He quoted George Washington as saying: "The government should do nothing for the people that the people can do better for themselves." He quoted Mr. Coolidge as saying: "It has always been the theory that the people shall own the government and not the government the people."

A member of the California State Railroad Commission, Mr. Leon Whitsell, spoke words of encouragement for the public service under so-called private ownership. Referring to the corporations of California he said: "They are now upon a higher plane under regulation than they could possibly be under the stress and strain of competition." He complimented the electric utilities upon the success of their efforts to make good public relations, and he thought much good had been done through the customer ownership plan adopted generally by the corporations. "It means," he said, "that there are 250,000 persons in California who have a direct personal interest in the public service. It means co-operation between the consumers and the companies; for, a man's interest grows in direct ratio to his knowledge of the subject."

At this convention Mrs. Sherman, President of the National Federation of Women's Clubs, delivered a striking epigram upon electricity in the home. "It is the electrocution of household drudgery," she said.

Under the heading, "The New Profession," the *Santa Ana Bulletin* in a recent issue published the following editorial upon the public utility situation of today:

"The management and operation of public utilities has developed a new profession—business administration or management—which is comparable with the term 'profession' in law, medicine and engineering, and incorporated into this daily task is the re-

sponsibility to the community and the insistence upon a high sense of public service.

"So far from the diffusion of ownership among five and one-half million security holders—with the resulting tendency to divide ownership from control and management—being a cause for alarm and apprehension, when properly analyzed it has seemed to be in the highest interest of both the stockholder and the public. It has created a demand for a new and distinct class of men, a new profession if you will, composed of men having, it is true, little financial interest in the properties, whose lives are devoted exclusively to operating these great public utility services. It is a welcome assurance to the public that whatever may be the result of the contest between conflicting financial groups for financial control of these properties, that notwithstanding the consolidations, mergers, and regroupings which the economies of the day seem to justify, the actual operation and management of these services must by reason of these very facts be committed more and more to the care of the class of public utility operators who have definitely devoted themselves to the public service."

Expenditures to date for hydro-electric development in the Pit River region amount to \$37,538,904. It is interesting to note that out of this total the sum of \$9,133,157 was spent for labor on the job, and approximately \$3,500,000 was spent locally for material and supplies.

MEDAL FOR SAVING LIFE

La Forest George Robinson, formerly in the employ of the General Construction Department as construction superintendent and foreman, has been awarded the Insull medal by the National Electric Light Association for saving a life.

The incident occurred December 31st last at Redwood City substation during the progress of construction work. John Mack, an electrical worker, accidentally contacted with a telephone switch which, owing to the proximity of the telephone line to a 60,000-volt electric transmission line, was carrying high-voltage induced current. Robinson, who was standing by, at once pulled Mack's arm from the switch, releasing him from the contact, and then applied artificial respiration through what is known as the prone pressure method, resulting in saving his life.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 865,000 CONSUMERS OF

GAS * ELECTRICITY * WATER * STEAM

2,472,404 Total Population Served in Thirty-eight of California's Counties
CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL		
	No.	Population	No.	Population	No.	Population	
Electricity	249	1,651,594	48	218,170	297	1,839,764	
Gas	71	1,662,100	6	20,702	77	1,682,802	
Water (Domestic)	18	16,000	6	19,550	24	35,550	
Railway	1	105,000			1	105,000	
Steam Heating	2	1,003,000			2	1,003,000	
Place	Population	Place	Population	Place	Population	Place	Population
¹ Alameda	35,140	Duncan's Mills	250	Lytton	100	² San Bruno	2,175
² Albany	6,000	Durham	600	Madison	300	² San Carlos	1,300
Alamo	100	⁵⁻⁶ Dutch Flat	400	Magalia	100	²⁻⁶ San Francisco	708,000
Alleghany	300	Dunnigan	150	Manteca	2,000	² San Jose	68,000
Alta	100	Eldridge	500	Manton	65	² San Juan	500
Alvarado	1,120	²⁻⁶ El Cerrito	3,000	² Mare Island	600	² San Leandro	12,000
Alviso	640	Elmira	300	² Martell	100	² San Lorenzo	1,000
⁵ Amador City	750	El Verano	500	Martinez	7,000	² San Mateo	11,500
Anderson	1,180	² Emeryville	5,000	² Marysville	8,500	²⁻⁶ San Pablo	1,500
Angel Island	500	Empire	250	Maxwell	600	² San Quentin	3,500
Antioch	2,800	Escalon	700	McArthur	167	² San Rafael	7,800
Applegate	100	Esparto	600	² Menlo Park	3,500	⁶⁻⁷ Santa Clara	6,500
⁶ Aptos	200	² Fairfax	1,200	Meridian	250	⁶ Santa Cruz	17,500
Arbuckle	900	Fairfield	1,200	² Millbrae	350	⁶ Santa Rosa	14,000
Artois	200	Fair Oaks	500	Mills	400	⁶ Saratoga	1,300
Asti	100	Fall River Mills	316	² Mill Valley	3,500	⁶ Sausalito	3,800
² Atherton	800	Farmington	300	Millville	200	⁶ Sebastopol	2,000
⁵ Auburn	3,000	⁶ Felton	300	Milpitas	400	Shavnut	100
Bangor	50	Finley	100	Mission San Jose	500	Shasta	46
Banta	50	Folsom City	1,500	Modesto	17,000	Shellville	200
² Barber	500	Forest City	200	² Mokelumne Hill	237	Sheridan	500
² Belmont	1,000	Forestville	300	⁶ Monterey	6,900	Smartsville	300
Belvedere	750	⁶ French Gulch	170	Monte Rio	500	⁶ Soledad	475
Benicia	2,750	¹ Fresno	72,000	⁶ Moran Hill	1,200	⁶ Soquel	875
⁶ Ben Lomond	500	Gerber	400	² Mountain View	3,000	Sonoma	1,000
² Berkeley	80,000	Geyersville	750	Mt. Eden	500	⁵⁻⁶ Sonoma	3,500
Bethany	50	⁶ Gilroy	3,700	² Napa	7,000	⁶ Sonoma City	200
Biggs	750	Glen Ellen	1,200	Nelson	50	⁶ South San	Francisco
⁶ Big Oak Flat	150	Gold Run	50	³⁻⁸ Nevada City	1,800	Francisco	6,500
Bolinas	400	⁶ Gonzales	500	Newark	1,100	Standard	800
Boyes Springs	1,000	Graton	250	² Newcastle	750	²⁻⁷ Stanford Uni-	versity
Brentwood	500	³⁻⁸ Grass Valley	6,000	Newman	1,250	versity	3,652
² Broderick	800	⁶ Gridley	2,500	Niles	1,850	Stanislaus	100
Browns Valley	125	Grimes	500	Nord	60	Stockton	55,000
² Burlingame	13,150	⁶ Groveland	250	²⁻⁶ Novato	1,000	⁶ Suisun	800
Butte City	200	Guerneville	1,200	¹ North Sacramento	2,500	Sunol	500
Byron	400	⁶ Hamilton City	300	Oakdale	2,000	² Sunnyvale	2,700
Calistoga	1,000	Hammonton	500	²⁻⁶ Oakland	295,000	Sutter City	500
² Campbell	1,500	² Hayward	5,000	Oakley	300	⁶ Sutter Creek	1,000
Camp Meeker	300	⁶ Healdsburg	3,000	Occidental	600	⁶ Tehama City	200
Cana	500	⁶⁻⁷ Hercules	600	Orland	2,100	⁶⁻⁸ Thermalito	250
⁶ Capitola	450	Hickman	40	² Oroville	7,000	Thornton	135
Carmel	2,500	² Hillsborough	1,000	Pacheco	300	Tiburon	500
Cement	1,000	⁶ Hollister	4,500	⁶ Pacific Grove	5,000	⁶ Towle	50
Centerville	1,775	Honcut	500	²⁻⁶⁻⁷ Palo Alto	9,550	Tracy	4,500
Ceres	1,100	Hopland	500	Paradise	600	⁶ Tres Pinos	400
² Chico	12,000	Hughson	625	Patterson	700	⁵⁻⁸ Tuolumne	1,500
Chico Vecino	2,500	³ Ione	900	² Penn Grove	250	Turlock	5,000
Cloverdale	1,000	Irvine	1,200	⁵ Penryn	250	Upper Lake	500
⁵ Colfax	800	⁵⁻⁸ Jackson	2,500	Perkins	350	⁶ Vacaville	1,000
College City	250	⁵⁻⁶ Jamestown	1,000	² Petaluma	7,500	Valley Home	200
Collinsville	300	Kelseyville	600	² Piedmont	9,000	²⁻⁶ Valejo	22,750
² Colma	2,900	Kennett	492	⁶⁻⁷ Pinole	1,000	Vina	300
⁵⁻⁶ Columbia	400	² Kenfield	1,000	Pittsburg	8,500	Vineburg	250
² Colusa	2,200	Kenwood	300	Pleasanton	1,800	Walnut Creek	2,500
Concord	4,200	Keswick	20	Port Costa	990	Warm Springs	300
Copperopolis	300	⁶ King City	1,600	Potter Valley	600	Waterford	700
Cordelia	350	Kingston	100	Princeton	300	⁶ Watsonville	4,300
Corning	1,800	Knights Ferry	200	² Red Bluff	3,500	⁶ Weaverville	500
² Corte Madera	1,000	Knights Landing	525	²⁻⁶ Redding	5,000	Whetland	650
² Cotati	600	La Fayette	300	²⁻⁶ Redwood City	8,000	Williams	800
Cottonwood	704	⁵ La Grange	200	²⁻⁶ Richmond	28,700	² Willows	3,000
Coyote	250	Lakeport	1,250	Riehvale	500	Windsor	600
Crockett	2,500	² Larkspur	1,000	Rio Nido	250	Winters	900
Crows Landing	300	Lathrop	300	Rio Vista	1,100	² Woodland	6,950
² Daly City	6,500	² Lawndale	100	Ripon	1,000	Woodside	300
Danville	500	⁵⁻⁸ Lewiston	100	Riverbank	1,200	Wyandotte	250
Davenport	500	⁵⁻⁸ Lincoln	2,000	⁶ Rocklin	700	Yolo	400
² Davis	1,750	Live Oak	1,000	⁶⁻⁷ Rodeo	500	² Yuba City	4,000
Dayton	60	Livermore	3,600	⁶⁻⁸ Roseville	7,000	Zamora	100
Decoto	700	¹ Lodi	5,000	² Ross	900	Total City	1,000
⁶ Del Monte	300	² Lomita Park	1,325	⁴ Sacramento	105,000	and Towns	1,984,400
Denair	400	⁵ Loomis	500	Salida	200	Add Suburban	Population
Dixon	1,200	² Los Altos	1,800	⁶ Salinas	6,500		488,000
Dobbins	100	² Los Gatos	4,750	San Andreas	600	Total Popula-	tion Served
Drytown	200	² Los Molinos	400	² San Anselmo	4,500		2,472,400
¹ Unmarked - Electricity only.		⁴ -Gas, Elect. and St. Railways.		⁷ -Gas supplied through other companies.			
¹ -Gas only.		⁵ -Electricity and Water.		⁸ -Water supplied through other companies.			
² -Gas and Electricity.		⁶ -Electricity supplied through other companies.		⁹ -Steam Heating.			
³ -Gas, Electricity and Water.							

San Bruno .. 2,175
 San Carlos .. 1,300
 San Francisco .. 708,000
 San Jose .. 68,000
 San Juan .. 500
 San Leandro .. 12,000
 San Lorenzo .. 1,000
 San Pablo .. 11,500
 San Pedro .. 50
 San Quentin .. 2,500
 San Rafael .. 7,800
 Santa Clara .. 6,500
 Santa Cruz .. 17,500
 Santa Rosa .. 14,000
 Saratoga .. 1,300
 Sealsalito .. 3,800
 Sebastopol .. 2,000
 Shawmut .. 100
 Shasta .. 46
 Shellville .. 200
 Sheridan .. 50
 Smartsville .. 300
 Soledad .. 475
 Siquel .. 875
 Sonoma .. 1,000
 Sonora .. 3,500
 Soulsbyville .. 200
 South San Francisco .. 6,500
 Standard .. 800
 Stanford University .. 3,652
 Stanislaus .. 100
 Stockton .. 55,000
 Suisun .. 800
 Sunol .. 500
 Sunnyvale .. 2,700
 Sutter City .. 500
 Sutter Creek .. 1,000
 Tehama City .. 200
 Thermalito .. 250
 Thornton .. 135
 Tiburon .. 500
 Tule .. 50
 Tracy .. 4,500
 Tres Pinos .. 400
 Tuolumne .. 1,500
 Turlock .. 5,000
 Upper Lake .. 750
 Vacaville .. 1,300
 Valley Home .. 200
 Vallejo .. 22,750
 Vina .. 300
 Vineburg .. 250
 Walnut Creek .. 2,500
 Warm Springs .. 300
 Waterford .. 400
 Watsonville .. 7,300
 Weaverly .. 500
 Wheatland .. 650
 Williams .. 800
 Willows .. 3,000
 Windsor .. 600
 Winters .. 900
 Woodland .. 6,950
 Woodside .. 300
 Yandotte .. 250
 Yolo .. 400
 Yuba City .. 4,009
 Zamora .. 100
 Total Cities ..
 and Towns .. 1,984,404
 Add Suburban ..
 Population .. 488,000
 Total Population ..
 Served .. 2,472,404



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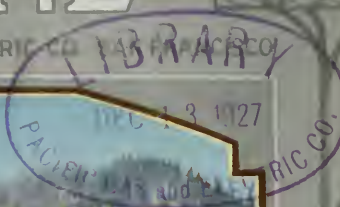
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PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO.



THE PICTURESQUE DAM
AT PIT 4 DEVELOPMENT

Vol
17

OCTOBER 1927

No
2

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		Sonoma
		San Jose
		Redwood City
		Redding
		Red Bluff
		Willows
		Red Bluff

Pacific Service Magazine

Volume XVII

Number 2

Contents for October, 1927



AUGUST F. HOCKENBEAMER	Frontispiece
OUR COMPANY'S NEW PRESIDENT	39
PROGRESS OF SALT SPRINGS PROJECT— PREPARING TO START WORK ON BIG DAM F. S. Myrtle	40
ON THE UPPER STANISLAUS—SPRING GAP POWER PLANT	48
OUR NEW HIGH-TENSION SUBSTATION AT SAN JOSE	53
FIFTY-THREE YEARS A LAKE TENDER— THE QUAIN'T STORY OF ED ROENING F. S. M.	56
THE STORY OF POWER IN CALIFORNIA (Concluded) A. H. Markwart	59
THE "PACIFIC SERVICE" ROLL OF HONOR	66
THE FINANCIAL SIDE OF "PACIFIC SERVICE" A. F. H.	68
EDITORIAL	70



AUGUST F. HOCKENBEAMER
President Pacific Gas and Electric Company. Elected August 16, 1927.

PACIFIC SERVICE MAGAZINE

Volume XVII

OCTOBER, 1927

Number 2

Our Company's New President

The board of directors of Pacific Gas and Electric Company, at a meeting held Tuesday, August 16th, 1927, elected Mr. A. F. Hockenbeamer president of the company to succeed the late Mr. Wigginton E. Creed.

Mr. Hockenbeamer's promotion comes to him after nearly twenty years of service in charge of the financial and other important branches of the company's working organization. His life story affords a striking illustration of the opportunity this country gives to the young man of energy and determination to rise from very small beginnings to position of power and influence.

August F. Hockenbeamer was born at Logansport, Indiana, March 6th, 1871, and received his early education in the public schools of that city. At a very tender age he started earning for himself by selling newspapers and distributing handbills; then he took a job as general utility boy in a book store. At sixteen he had mastered the intricacies of the stenographic art and secured a position in the office of Mr. L. F. Loree, then a division engineer on the Pennsylvania lines and now head of two great railway systems in the East. His work was of an inconspicuous character at first, but he persevered and eventually rose to important railroad positions, among these being that of assistant engineer of maintenance and that of assistant general superintendent of motive power, both of the Baltimore and Ohio Railroad, and, finally, assistant to the president of the Rock Island-Frisco system. He was in Mr. Loree's confidence and rose with him. He remained in the railroad business altogether sixteen years.

In 1904 he entered the employ of N. W. Halsey & Co., the Wall Street bond house, where, in addition to investigating railroad companies for investment purposes, he gave his attention to street car, gas and power concerns and other public utilities. In 1907 he was concerned with the financial reorganization of Pacific Gas and Electric Company, his firm being large holders of P. G. & E. stock and heading a syndicate which underwrote a \$6,000,000 bond issue for the company. He came to San Francisco to make the necessary investigation of P. G. & E. properties and there he attracted the favorable attention of Mr. Frank G. Drum, then our company's president. Upon Mr. Drum's invitation and with the consent of the New York house Mr. Hockenbeamer agreed to stay with the company for one year as comptroller. Six months later he attached himself to "Pacific Service" permanently by accepting the office of treasurer. In 1910 he was elected second vice-president and made a member of the board of directors. During the past seventeen years, therefore, he has had the opportunity of becoming thoroughly conversant with the company's major activities and policies.

Mr. Hockenbeamer achieved national fame in 1914 when he inaugurated the plan of customer ownership. At the first attempt an issue of \$12,500,000 preferred stock was sold over the counter to existing stockholders, customers and employees at a cost to the company of one-half of one per cent. His pioneership of this now generally accepted policy on the part of the utilities of the country has been universally recognized and acknowledged.

He assumes the presidency of "Pacific Service" with the best possible training for the office. He is liked and respected by all who know him. One and all, we of the "Pacific Service" family give our new president hearty greeting and assure him of our undivided loyalty and support.

Progress of Our Salt Springs Project— Preparing to Start Work on Big Dam

By FREDERICK S. MYRTLE

In the upper reaches of the Mokelumne River, within a few miles of the border line of Alpine County, at the bottom of a deep gorge lying 3,000 feet below the Alpine highway, our company's construction engineers are about to start work upon a huge rock-fill dam that, when completed, will be the largest of its kind in the world.

In the July, 1926, issue of *PACIFIC SERVICE MAGAZINE* our readers were made acquainted with the details of a water and power project of considerable magnitude about to be undertaken in the far reaches of the Mokelumne about fifty miles upstream from the company's great power plant at Electra, which lies on the north bank of the river distant some eight miles from Jackson, the county seat of Amador. This project, it was explained at the time, was planned to provide increased power and water facilities for the Electra system. The following were given as its major features: Construction of a rock-fill dam, 300 feet in height, on the river at Salt Springs, a point approximately

four miles upstream from the junction of the river with its principal tributary, the Bear; construction of a water conduit from the intake at the dam a distance of, in round numbers, twenty-five miles to the point where Tiger Creek flows into the Mokelumne and where a small dam across the river marks the intake of the Upper Standard canal, one of the two main feeders of the Electra system; erection of a hydro-electric plant of 72,000 horsepower capacity on the north bank of the river at the point of its junction with Tiger Creek, where there is a drop of 1200 feet from the line of the water conduit from Salt Springs; enlargement of the Upper Standard canal in order to accommodate the additional flow of water from Salt Springs.

The preliminary article referred to detailed at length the story of hydro-electric power development on the Mokelumne River, from the incorporation, in 1890, of the Blue Lakes Water Company, with its cluster of reservoirs in Alpine County, down to the construction, in 1902, of the great



Site of the Salt Springs dam Lines show crest of dam and outline of north abutment.

Electra plant, with a generating equipment of 26,000 horsepower capacity. Ever since its first installation the Electra system has derived the greater part of the water needed for its operation from the Mokelumne River into which the Alpine County reservoirs discharge, as also a number of tributary streams, such as the Bear, Cole Creek, East and West Panther Creek and Tiger Creek.



View upstream from top of projected dam.

There is a reservoir on Bear River, made by damming the stream at a point upon the ridge above the Salt Springs site, and the water impounded thereby has made the Bear the most important of the tributaries named. The Electra ditch system in this part of the territory begins at the Upper Standard canal at Tiger Creek and is reinforced by the Lower Standard canal, whose intake is about

two miles downstream from the other. The Upper Standard canal carries the water a distance of about twenty-two miles and delivers it into the Petty reservoir, on a plateau above Electra, where there is a drop of 1450 feet to the power-house. The Lower Standard, reinforced on its journey by water from the Amador ditch, a conduit coming in from the northwest, feeds into a picturesque body

of water known as Lake Tabaud, from which the drop to the power-house is 1250 feet.

For some time past, however, plans have been under consideration for enlargement of the water storage facilities in the Electra system. The Salt Springs project now under way was already in existence, to the extent that certain private holders of a considerable stretch of forest territory along



Looking down stream from the dam site.

the Mokelumne River in that section were in possession of a license from the Federal Power Commission for the construction of a dam at the spot indicated for irrigation purposes. The purchase of their rights, with the necessary transfer of government license, marked the initial step in one of the most important water and power projects our company has undertaken. The additional water supply from the Salt Springs reservoir, which is estimated at 130,000 acre-feet capacity, means millions of additional kilowatt hours for our company's consumers in that section of the "Pacific Service" territory, and the advantage that will be taken by our company's hydro-electric construction department of the available flow of water through the conduit between Salt Springs and Tiger Creek, estimated at 450 second feet, will mean many thousands of additional kilowatts of hydro-electric energy to be poured into the "Pacific Service" power-pool.

The site of the Salt Springs water storage project lies at the bottom of a gorge on the Mokelumne River at Dead Man's Flat, an open space which derives its name from the fact that a man has lain buried there for upwards of twenty years. Besides being a picturesque spot, it is an ideal location for the

construction of a rock-fill dam of the magnitude and character projected. Great granite bluffs rise from either bank of the stream, which marks the border line between the counties of Amador, on the north, and Calaveras, on the south. Two historic eminences face each other a short distance below the site, that on the south or Calaveras County side of the river being known as Calaveras Bald Rock and that on the north or Amador County side as Amador Rock.

The river flows past the dam site at an elevation of 3,650 feet above sea-level. Along the top of the slope on the Amador side, upwards of 3,000 feet above the river, stretches the Alpine highway into Nevada. This runs out from Jackson by way of the ridge that separates the watershed of the Mokelumne River from that of the Consummes and winds around by way of Silver Lake and Hope, Faith and Charity valleys into Nevada, passing within measurable distance of the lower end of Lake Tahoe. The highway runs past Pine Grove, Cook's and Ham's, all wayside resorts typical of the Sierra Nevada country, and reaches the summit at Peddler Hill, a point about forty miles out from Jackson, where the elevation is 7,280 feet above sea-level. Almost directly under the summit lies the site of Salt Springs



View down river from road near the top of the dam. Calaveras Bald Rock at left. Amador Rock at right.

dam. The river bottom at the site is filled to a depth of possibly fifty feet with great granite boulders and debris. There is no dearth of rock in that section of the country.

The dam itself will consist of a huge inverted wedge of "drop-fill" rock, rising 300 feet above the present stream bed and with a crest length of 1300 feet. The crest will be fifteen feet wide, and from it the upstream face of the dam will be carried at an angle of $37\frac{1}{2}$ degrees to the surface of the stream, while the downstream face will be constructed on a slope of $35\frac{1}{2}$ degrees. As a result there will be a length of 800 feet between the upstream and downstream toes of the dam, and in that length the river drops twenty feet. The upstream surface will be protected by a water-tight facing of reinforced concrete, graduating from a thickness of three feet at the bottom to one foot at the top. Underneath this will be a layer of derrick-placed rock fifteen feet in thickness. On reaching the surface of the river the concrete facing will be carried down to bedrock and there made secure against seepage, and the placed



Erecting the construction camp on Dead Man's Flat; here 300 employees will be housed.

rock layer will be carried down with it in order to give it support.

Particular care will be taken with this upstream face. In the layer of placed rock each piece will be set by a derrick and all the intervening chinks filled as solidly as practicable with smaller fragments. This, of course, is done to furnish adequate surface and support for the outside concrete slab, upon which dependence is placed to render the dam water-tight. Suitable expansion joints will be introduced into this slab to prevent its being ruptured under tempera-

ture and settlement strains, there being considerable variation between summer and winter. Should any water chance to seep past this concrete face, it will readily drain off through the porous rock-fill without in any way endangering the structure.

When completed, Salt Springs will be the largest and most imposing rock-fill dam in the world, judging from the standpoints of height, width at base and volume of rock content. Some idea of its dimensions may be gathered from the fact that in solid content it will be seven times the size of the dam at Lake Fordyce, which



Electric power shovel used to load large rock from quarry into dump cars. This is mounted on caterpillar traction. Its dipper is of four cubic yards capacity. Operated by one man.

contains 380,000 cubic yards of material as against 2,500,000 cubic yards that will be required to complete the Salt Springs structure. A more generally comprehensible estimate of its volume is furnished by the statement that it will equal the aggregate cubic content of twenty-four buildings of the size of our company's general office building in San Francisco.

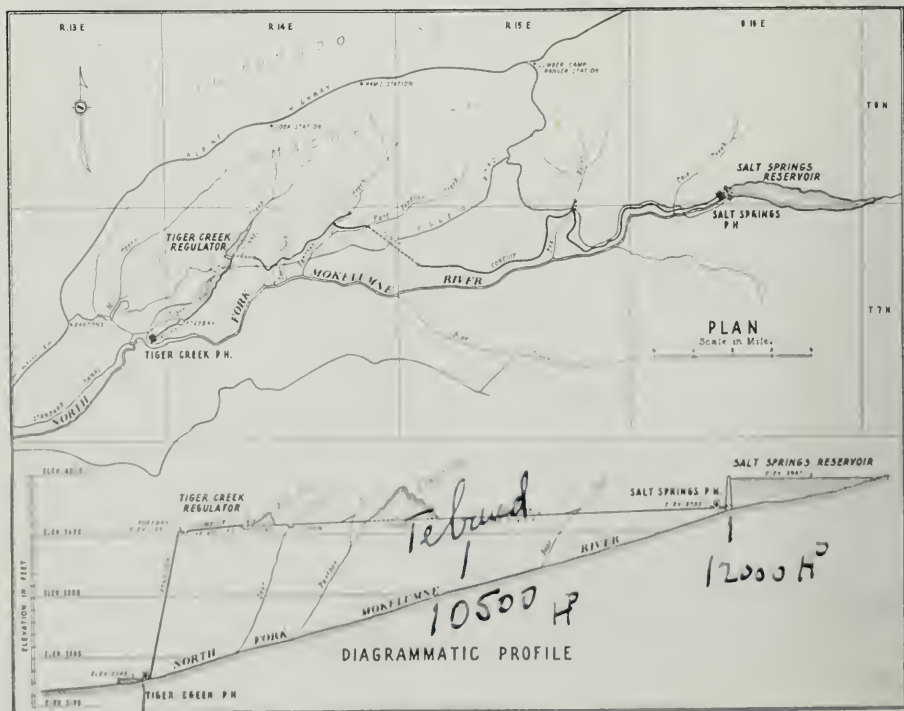
This dam will impound the water of the Mokelumne into a reservoir of 130,000 acre-foot capacity. This in volume is about equivalent to the present water consumption of the entire city of San Francisco for 1,060 days.

While the Mokelumne River at this point is not a flashy stream, as such streams go, at rare intervals it has been known to produce a flood of 16,000 cubic feet or more per second. To prevent such floods from overtopping the dam, a spillway of 32,000 cubic feet per second capacity will be cut from the solid rock in the form of a side channel leading from the south or left abutment. This spillway channel will have a free crest, without gates, stop logs or other mechanical device.

During the construction of the dam it will be necessary to divert the Mokelumne from its natural channel. This will be accomplished by means of a temporary diversion dam, which will direct the water into a diversion tunnel, 19 feet in diameter and about 1000 feet in length, bored through the granite bluff on the north or right bank of the river. While the cut-off wall foundation in the river bottom is being placed and the huge dam is being constructed above, the entire flow of the river will be safely disposed of through this tunnel.

Upon completion of the dam, the gates of this diversion tunnel will be closed and the river will again return to its natural channel and begin to fill the reservoir back of the dam. The diversion tunnel will then be made use of as the permanent discharge outlet from the dam through which the stored water will be released to the plants below.

A new feature of this construction work, that is, one to which public attention has not before been called, is the projected construction of a Salt Springs power plant at the



Plan and profile of our Salt Springs water and power project.

lower end of the discharge tunnel, where advantage will be taken of the head created by the dam to generate a considerable quantity of power from the escaping water. The present plan is to erect there a power-house of 12,000 horsepower capacity, the power there generated to be transmitted down river and merged with that generated at Tiger Creek power-house and other plants of the Electra system.

The conduit which will convey water from the dam to the Electra system below Tiger Creek will be part tunnel, part open conduit. It will be altogether 111,600 feet in length and will be of 500 cubic feet per second capacity. On its run along the north bank of the river it will pick up water from Bear River, and East and West Panther Creeks. On arrival at Tiger Creek, its water will be discharged into a forebay at the lower end of which the conduit will be resumed for a distance of 14,000 feet over a ridge to a point overlooking the stream where there is a drop of 1200 feet. That point will mark the head of the penstocks that will carry the water into the power-house below.

Tiger Creek forebay will be of 250 acre-foot storage capacity. The height of the dam will be 100 feet.

Tiger Creek power plant will be, according to present rating, of 72,000 horsepower capacity. The energy generated there and at the Salt Springs plant will tie in with the "Pacific Service" system by transmission line



Bridge over the Mokelumne below the dam.

to Newark, by way of Electra, according to present plans. Three-quarters of a mile below the power-house the progress of the stream will be again checked by a 65-foot dam, which will create an afterbay. This will serve the usual purpose of maintaining the even flow of the stream against irregularities in demand upon the power-house.

In order to accommodate the flow of water to Electra, it will be necessary to increase Upward Standard canal to 500 second feet capacity. There is no talk of enlarging Lower Standard canal; in fact, that may eventually be abandoned.

Preliminary work on the project was begun in June last year. At that time there was no available means of transportation to the dam site from the highway several thousand feet above. There was, however, a small road leaving the highway at a Forest Ranger station some thirty-seven miles out from Jackson and where the elevation is 6,500 feet above sea-level,



Company's sawmill, about two miles below dam site. All lumber for the project will be cut here.

and which plunged down the slope a distance of five miles to a holding known as the Ellis ranch; this road our company's engineers decided to make use of, reconstructing it and carrying it down to a point where the Bear River crosses on its way to join the Mokelumne, a drop of 3,000 feet from the highway, and from that point along the north bank of the river to the dam site, a distance of all together thirteen miles. This road has recently been completed and trucks carrying machinery and supplies grind their way along it daily to and from the company's temporary headquarters at Martell, a small town about two miles from Jackson and marking the terminus of the railroad running out from Galt, a station on the main line of the Southern Pacific above Stockton, by way of Lone.

During the past year, however, another



Truck bearing bed of dump car to be used to haul rock from quarry to dam.
View taken on Company's road from Ranger Station into Salt Springs.

road in to the dam has been constructed and at the time of writing is reaching completion. This road takes off the highway at Barton's, twenty miles out from Martell. Here the elevation is only 3,300 feet, and the road winds its way to the Bear River crossing before mentioned by way of Tiger Creek, passing the old Tiger Creek sawmill that was part of the original Electra construction project and within four miles of

Tiger Creek power-house site. The Tiger Creek road joins the first road built by our company at Bear River crossing and takes the same course in to the dam site. The total length of the road from Barton's to the dam is a shade under twenty-nine miles, one mile shorter than the way by the Ranger Station and involving no grade worth mentioning. This new road is a much more elaborate affair than the other one. It is wide and well laid, and when one takes into consideration the granite formation of those Amador slopes one may well hail it as a tribute to the



View on the Company's new road from Barton's to the dam, by way of Tiger Creek.

engineering skill of our company's road-builders. It is surfaced with crushed rock and is solid enough to stand much wear and tear from trucks and other vehicles of transportation. Being at a lower elevation than the other, it avoids the heavy snows of winter, and so is an all-the-year-around thoroughfare.

The matter of road-building for construction purposes is interesting in itself. First of all, a gang is sent out to clear the right-of-way in a path about fifty feet wide. The next gang builds a trail on the inside of the right-of-way about four feet wide, and any obstructing rock or hard surface is removed by drill and powder. Next comes an electric shovel, which does the work of a host of men in completing the roadway. The final stage is reached when a caterpillar and a big grader or scraper arrive on the scene to smooth off the surface. Sometimes, as in the case of the Tiger Creek road, crushed rock is laid down to furnish good going for heavy traffic. One hundred and fifty men were employed on this job.

Road-building represents the most important work that has been accomplished since a start was made. Access being thus gained to Dead Man's Flat, the dam site has been cleared of rough timber, a considerable portion of this being taken to a sawmill erected by men of the company's construction crew two miles down river, where all the lumber for the project will be turned out. There is a temporary construction camp located about one-half way between the sawmill and the dam, where the men are housed in tents. For construction purposes a 60,000-volt electric transmission line has been constructed between Electra and Tiger Creek and a 17,000-volt line between Tiger Creek and the dam. Telephone communication has also been established.

So much, then, for what has already been accomplished; but now that the preliminaries are out of the way, work on the dam itself is in order. Ever since the road was open to the dam the construction department has been installing equipment. At the present time two electric power shovels are stationed on the job. One is a giant affair, mounted



Warehouses and yard at Martell, temporary construction headquarters.

on a caterpillar traction and operating a dipper of 4 cubic yards capacity. This is stationed on the north bank of the stream and will be used to lift rock quarried from the granite bluff half a mile above the dam site and dump it into cars for conveyance to the dam. It is operated by one man. The other shovel is at present stationed on the south bank of the stream, on the road leading up from Dead Man's Flat to the dam crest on the Calaveras side of the river and is of $1\frac{3}{4}$ cubic yards capacity. This will operate at a quarry almost opposite the other. Trains will operate to carry rock from the quarries to the dam. Six large dump cars, each of 30 cubic yards capacity, and four 20-ton storage battery locomotives, standard gauge, constitute the hauling equipment.

The first work to be undertaken on the dam will consist in dumping rock into the abutments on either side. This will start at once and will be a big job. The canyon is so wide at that spot that the construction department estimates that the dumping process can be carried on for the better part of a year before it will be found necessary to drain the river for foundation purposes.

At Dead Man's Flat a permanent construction camp is in process of erection which will be capable of housing 300 men. This will be in commission all winter, for there will be no let-up in operations at the dam site. A small gang of men will work at the sawmill until an amount sufficient for temporary purposes has been cut and then the mill will shut down for the winter. There is no talk of working on either the tunnel or the power-house project until work on the dam is well advanced.

On the Upper Stanislaus— Spring Gap Power Plant

In the July number of *PACIFIC SERVICE MAGAZINE* announcement was made of the acquisition by our company, through purchase from the Byllesby interests of Chicago, of the Sierra and San Francisco Power Company, the Western States Gas and Electric Company and the Coast Valleys Gas and Electric Company, all three public utilities operating in central California. It was stated then that the two last named utilities were new additions to the "Pacific Service" chain, but that the properties of the first named had been operated by our company for the past seven years under lease.

Shortly after this lease was executed, an illustrated description of the Sierra and San Francisco power system was given our readers. At that time the system contained two water-power plants fed by the Stanislaus River and tributaries; of these the Stanislaus plant, on the middle fork of the river, was the only one of magnitude and stands today as the controlling plant of the system with an installed capacity of 45,576 horsepower. Later on, however, an important addition to the system was made in the construction of Spring Gap power-plant, also located upon the middle fork of the Stanislaus and of 10,054 horsepower capacity; it is with this most recent plant that the present article has to deal.

The entire system derives its sustenance from the mountains of Tuolumne County, in the Stanislaus national forest. Two large reservoirs store the water, one Relief reservoir, situated some 60 miles above Sonora and nestling among the rocky peaks of the Sierra Nevada within ten miles of the summit, which is crossed by the Sonora pass on the old Mono highway; this feeds the middle fork of the Stanislaus River. The other reservoir is Strawberry, situated about 30 miles south of Relief on

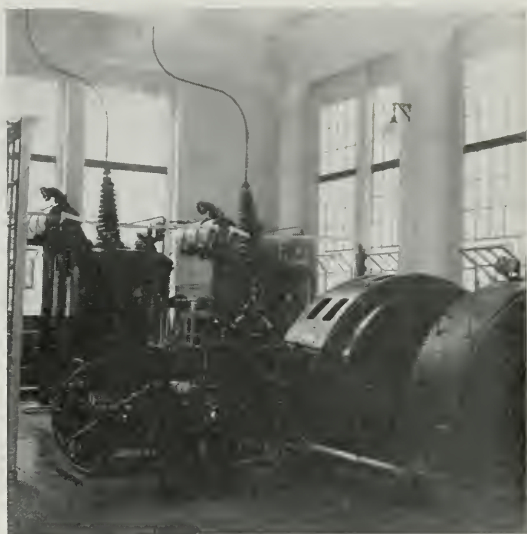
the south fork of the Stanislaus, which thence takes a southwesterly course across country to join the main stream a short distance above Melones.

At a point about six miles below Strawberry reservoir a conduit named the Philadelphia ditch diverts water from the south fork of the river and conducts it across the ridge separating the south fork from the middle fork to a point where it is discharged into the middle fork to feed Stanislaus power-plant; the point of contact with the middle fork is called Baker's Crossing and there stands Spring Gap power-house, fed by water from the Philadelphia ditch from a drop of 1,865 feet.

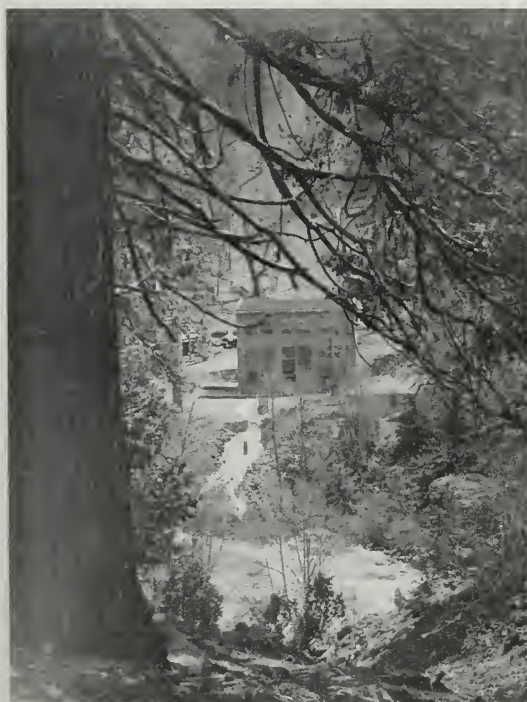


View of Spring Gap power-house, on the middle fork of the Stanislaus.

Spring Gap is almost inaccessible to the visitor from the mountain side, but there is an interesting and quite picturesque approach from Stanislaus power-plant about twenty miles down stream. This is located on a bend of the river on the south or Tuolumne side about twenty-five miles from Sonora, but the approach by road is from the Calaveras County side by way of Angels Camp, which is about fifteen miles distant. From the power-house on the river bank ascent is made by tramway paralleling the pressure pipe lines to the forebay reservoir lying on a plateau some 1500 feet above the stream. Here is met the Stanislaus flume, which conveys water to the power-house from the diversion dam at Sand Bar, sixteen miles up stream. The flume clings to the precipitous sides of the canyon, winding in and out of ravines and crossing deep gullies



Interior of Spring Gap power-house.



A glimpse of the power-house from the north bank of the river.

on high trestles, following the tortuous course of the stream all the way to the point of intake. A 36-inch gauge railroad is located on top of the flume, and over this runs a lumber train drawn by a Ford truck car.

A journey over this railroad is really worth while. Some little engineering difficulty was encountered in its construction by reason of the extremely sharp curves, so that it was found necessary to limit the wheel base of the car to 48 inches. As the length of the Ford engine is nearly three feet, some idea may be gained of the remarkable proportions of this machine. A worm-drive Ford truck chassis is utilized, the frame cut to the required wheel base and flanged wheels set to a 36-inch gauge installed in place of the usual rubber-tired wheels. The speed is limited to 10 miles an hour, so that during the 16-mile trip one has ample time to enjoy the magnificent scenery along the route.

It is four miles from the head of the flume at Sand Bar dam to Baker's Crossing, where the Spring Gap power-house is located, and the trip

is made on horseback. Here the trail follows the new transmission line that carries the output of the Spring Gap plant to the steel tower line at Stanislaus. This line is of double-pole construction, carrying one 3-phase aluminum circuit hung on suspension insulators. Heavy timber and brush are encountered for almost the entire length of the right-of-way. The trail follows close to the river bank, a large portion having been blasted out of solid rock. Spring Gap power-house lies on the south river bank, just above Baker's Crossing bridge. The building is of reinforced concrete, 53 by 45 feet in measurement. Cottages, warehouse, shop, etc., constitute quite a settlement.



Stanislaus river in vicinity of Spring Gap.

The power-house location is particularly picturesque. Most of the brush in the immediate vicinity has been cleared, but many large sugar pine and red cedar trees remain. There is a considerable stretch of comparatively level bench land on the power-house side of the river, admirably suited for the operators' cottages, while on the opposite bank is a piece of meadow land which may be later utilized for orchards or gardens. Easy access to this piece of ground is afforded by means of the picturesque old Baker's Crossing bridge.

From the power-house ascent is made up the tramway paralleling the penstock to Spring Gap proper. The tram climbs some very steep pitches, a slope of 48 degrees being encountered at one point. The tramway is about 8,000 feet in length and rises from an elevation of 3,009 feet at the power-house to 4,872 feet at the pipe line intake, or a rise of 1,863 feet, which is the total head of the penstock. On both sides of the way is a heavy stand of timber. Through the trees, to the east, is spread out a wonderful panorama of the higher Sierras, the snow-clad summit of the Dardanelles looming up as a prominent feature.

A little over half way up the steep incline the tram car crosses over a high trestle, beneath which are the tracks of the Sugar Pine railway. The railroad is built on the grade established by the old Miners' Ditch, closely associated with the early history of the Mother Lode country. Its total length, from its original intake above Donnell's Flat on the middle fork of the Stanislaus to the Columbia basin, was over sixty miles. Its width varied from six to eight feet on the bottom. It originally carried water along

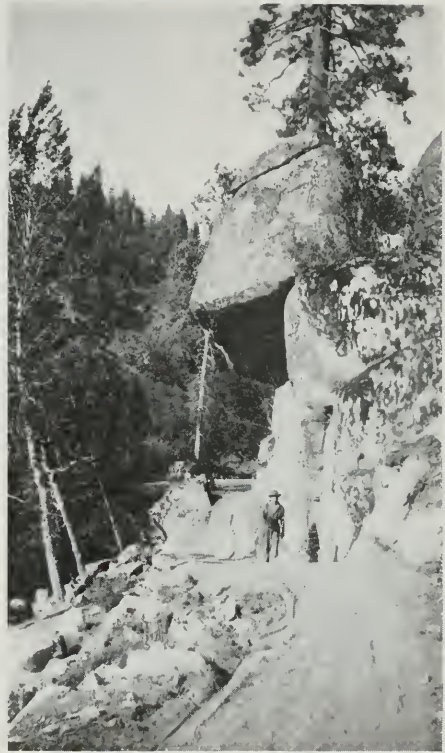


Header-box and spillway at head of Spring Gap penstock.

the canyon of the middle fork to Spring Gap, where a tunnel cut through the divide and dropped the water into the south fork. Here it flowed in the natural river channel for about two miles, where a dam across the river diverted the flow to a second ditch, extending to the Columbia placers.

The Miners' Ditch was completed about the end of the year 1859. Notwithstanding its age and long disuse, it is still, for the most part, in excellent condition. In the early days in which it was excavated, water was greatly in demand and many disputes arose over water rights. Feeling between competing companies ran high, at times resulting in litigation and feud, even bloodshed. The Tuolumne County Water Company, supplying Columbia in the fifties, attained a monopoly and the rates charged were high; but while the mines remained profitable little protest was evoked on that account. However, as gold grew less plentiful, the miners rebelled and organized the Columbia and Stanislaus River Water Company, spending more than a million and a half in less than two years and putting into operation the Miners' Ditch. The day water was turned into the new ditch the rates of the opposing company fell and a bitter war resulted. The miners operated their ditch for about two years, but the company finally became bankrupt and the property was sold out under the hammer to the competing company for only \$120,000.

The hoist which operates the tramway is an interesting piece of machinery. It was built especially for the job by the Joshua Hendy Iron Works of San Francisco. The diameter of the large gear is 11 feet. The hoist is at present equipped with 8,000 feet of $\frac{7}{8}$ -inch plow steel cable, while an equal length of $\frac{1}{8}$ -inch cable was provided for lowering the heavier pieces of the power-house equipment. A double set of gears is



View on trail between Sand Bar dam and Spring Gap.

provided, allowing the heavier loads to be lowered at about one-quarter the normal operating speed. This device has been made "fool-proof" by keeping the shift locked at all times. An elevated platform enables the operator to "spot" the tram car at the proper place for loading at the upper end of the tramway. The hoist is operated by a 112-horsepower motor, electric power being brought from Spring Gap power-house over a 17,000-volt transmission line and stepped down to 440 volts.

The tracks of Sugar Pine railway, a standard gauge logging road, cross the divide at Spring Gap near the head of the tramway, providing transportation facilities when the railroad is in operation. During the winter months, however, due to slides, snow and washouts, it does not operate and all miscellaneous supplies must be hauled sixteen miles by truck from Angels, hoisted up the Stanislaus tramway and transported along the tortuous course of the flume to Sand



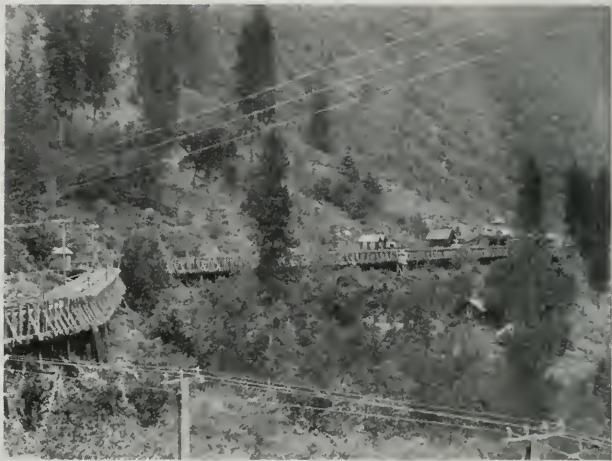
Ford tractor hauling poles on flume.

Bar. Here horse-drawn sleds must be employed over the trail to the power-house.

While the power-house is situated on the middle fork of the Stanislaus and discharges its spill into that stream, the water for its operation, as already told, is obtained from the south fork of the same river. The Philadelphia ditch is approximately six miles in length, terminating at the head of the penstock. This ditch was excavated several years ago, its discharge spilling down the hillside through a natural water course to augment the flow of the middle fork for the operation of the Stanislaus plant. The capacity of the ditch is fifty cubic feet per second.

The Spring Gap development entails no forebay and therefore the plant output is governed by the flow of water in the Philadelphia ditch. The power house operates at 100 per cent load factor, in parallel with the rest of the system.

The equipment of the Spring Gap plant is briefly as follows: A riveted steel pressure pipe line approximately 7,500 feet in length and varying in diameter from 37 $\frac{1}{4}$ inches



Typical view of the Stanislaus-Sand Bar flume.

at the top to 32 $\frac{1}{2}$ inches at the bottom supplies water to one 9,500-horsepower Pelton horizontal tangential water wheel, driving one General Electric 7,500 K.V.A. generator. A bank of three 2,500 K.V.A. General Electric transformers "step up" the voltage from 6,600 to 104,000 volts for transmission to Stanislaus. The transmission line is connected through automatic switches to the two Stanislaus-San Francisco 104,000-volt tower lines.

The power developed at Spring Gap, in conjunction with that generated at Stanislaus, is transmitted first to Manteca substation, where a portion is taken off to supply a large agricultural load in the San Joaquin Valley. The greater portion, however, is sent out in a westerly direction to the San Francisco peninsula and points south as far as Salinas. It supplies the motive energy for the Market Street Railway Company's system in the metropolis.

Spring Gap is the second highest head on the system operated by "Pacific Service." It yields pride of place in this respect only to El Dorado, of the recently acquired Western States properties on the American River, where the head is 1,910 feet. Spring Gap recently came into prominence through being awarded premier place among the plants of the "Pacific Service" system for housekeeping.



An official inspection of Spring Gap. The late Mr. W. E. Creed seated beside Mr. P. M. Downing and Mr. Lester S. Ready of the Railroad Commission.

Our New High-Tension Substation at San Jose

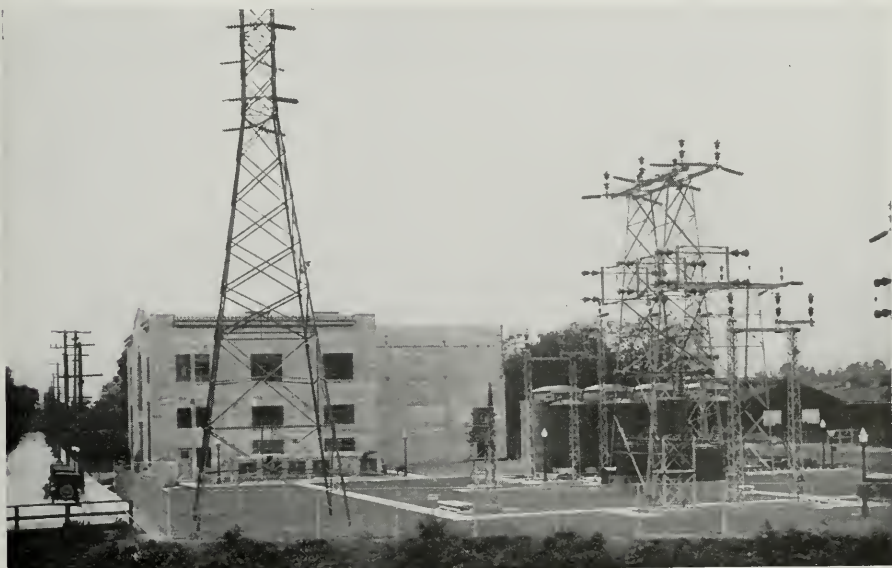
To keep pace with the rapid growth of the territory in and adjacent to the city of San Jose and the consequent demand for additional electric power to serve the factories, farms and homes in the Santa Clara Valley, our company decided early in 1926 to construct a new high-voltage substation in the Garden City.

All of the power used in San Jose and the adjacent territory had previously been carried directly from Newark substation to Station "A," San Jose, at 60,000 volts and there reduced to 11,000 volts to be distributed over the surrounding territory. It was decided that the service would be greatly improved by changing the Newark line to 110,000 volts and by rerouting it to a new substation which could also distribute to its vicinity. This new substation, therefore, is for the purpose of receiving the electrical energy coming in over the 110,000-volt lines from Newark substation and transforming it down to 11,000 volts for distribution over

the city and part of Santa Clara Valley.

This substation, called Station "B," San Jose, is now complete and in service. Construction work was started early in September of last year and such satisfactory progress was made that on April 18 last the station was finished, approximately two months ahead of schedule time. The location is on the corner of Fox Avenue and Santa Teresa Street, on the east bank of the Guadalupe River, just north of the Southern Pacific right of way. This location is ideal, for it is in the industrial section of the city and, consequently, close to the industrial load.

The substation building was designed to house only the 11,000-volt equipment, which includes the switches, switchboard, synchronous condenser and miscellaneous apparatus, since it was deemed advisable to use outdoor type transformers due to their high voltage. The building, however, is so planned that should another condenser and additional



Station "B," San Jose, and yard, showing incoming Newark line, switch structure, switches and main transformer bank

switching equipment be deemed necessary at some future date, it can be enlarged without marring it architecturally. The building is a well-designed, two-story, reinforced concrete structure, "L" shaped, with a frontage of 81 feet on Fox Avenue, while on the Santa Teresa Street side it is 102 feet long. The building is 40 feet high and has a 16-foot basement. It is of Spanish Mission



Bench board and instrument panel in operating room of Station "B,"
San Jose

design, with the exterior and interior walls unplastered, which leaves the rough concrete exposed and creates a pleasing effect.

The substation yard comprises $2\frac{1}{4}$ acres. To the southwest of the substation building the incoming two-circuit 110,000-volt tower line from Newark ends in a massive switch structure, which supports two 110,000-volt oil circuit breakers, one for each line. These great circuit breakers, which have a capacity of 400 amperes, and the equipment for operating them, were manufactured by a local firm, the Pacific Electric Manufacturing Company of San Francisco. They are of unusual interest by reason of the high speed at which the circuit is broken, approximately 84 feet per second, and also due to the fact that the operating device is one which was invented by the engineers of our own company and used here for the first time on a circuit breaker of this size.

Through these circuit breakers the current is carried to the main transformer bank, which has a capacity of 30,000 kv-a. The bank is made up of three 10,000 kv-a transformers, while a fourth is provided nearby, ready to be put in service at a moment's notice should one of the others fail or be in need of repairs. It is interesting to note that owing to the extreme size of the transformers, which weigh 27 tons each, it was necessary to transport them from the factory on a special underslung flat car and to haul them from this car to the building on an extremely

heavy trailer. A special track and car are provided in the substation yard to facilitate the handling of these transformers out of doors and to aid in getting them within reach of the powerhouse crane. The current enters these transformers at a voltage of 110,000 and, leaving it at a voltage of 11,000, is conducted into the substation building, where a part of it enters the synchronous condenser.

This condenser is another piece of equipment which proved rather difficult to handle. Its total weight is 75 tons, which was too great to be handled in one piece with the equipment available, so it was dismantled and handled in this manner. Even so, the heaviest part weighed 32 tons, which was quite enough. The purpose of this condenser is to maintain a constant voltage, which is extremely desirable and very difficult when motors and lights are being snapped on and off so continually over the whole territory, and to maintain a favorable power factor.

From here the current is carried out of the substation at 11,000 volts through six underground feeder circuits, four to Station "A," San Jose, from which it is dispatched over the city by means of distribution circuits, and two direct from Station "B" to the outlying districts. On these distribution circuits the voltage is further reduced by means of small distribution transformers placed at strategic points around the circuit, from 11,000 volts to the voltage necessary

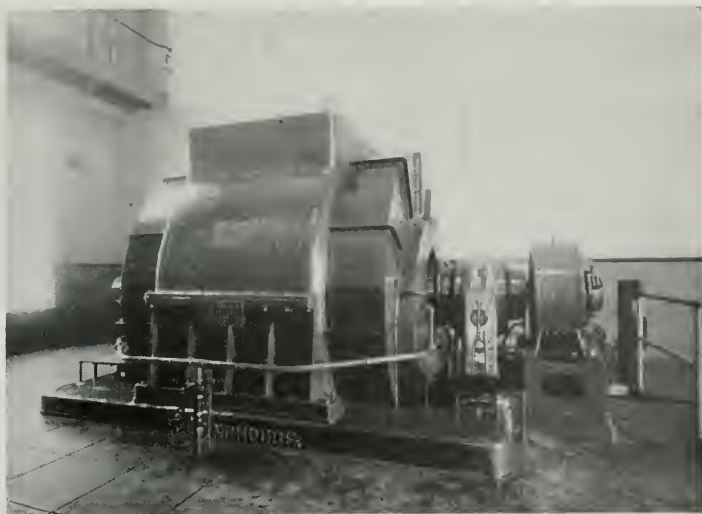
to drive motors and furnish light and heat.

The 11,000-volt oil circuit breakers which control the 11,000-volt circuits in Station "B" are all arranged with double bus connections so that should one set of connections fail the other can be immediately put into service, so that no interruption results. The operation of all of these switches as well as that of practically all of the apparatus in the station is controlled from the bench type switchboard, which, with the instrument panel, is located in the operating room on the third floor of the substation building.

From this room, which is glassed in to aid in sound-proofing it, the operator has a clear view of the condenser on the main floor of the building as well as an unobstructed view of the station yard where the incoming lines and the mammoth circuit breakers and transformers are located. From this room also the operator, by pressing buttons and turning keys located on the switchboard, can operate practically all of the equipment in the station while, by means of the instrument panel and the various indicating devices which are provided, he can readily determine the condition of the apparatus.

The power to operate the switches comes not from the main incoming line to the station, as might be supposed, but from storage batteries, the effect of this being to further safeguard the station by permitting the operation of the equipment even though the incoming lines should, for some reason, be without power. This enables the operator to place the station equipment in readiness to receive the power when it does come in.

Due to the size of the substation and the necessity of making speedy repairs to any apparatus which might fail in service, complete provision is made for the speedy handling of all but unusual repairs and mainte-



15,000 KV-A synchronous condenser on main floor of Station "B,"
San Jose

nance work. There is a small but complete machine shop located on the main floor of the station, while a 50-ton crane covers the main room to permit the easy handling of the large apparatus. Working on a transformer in inclement weather is thus greatly facilitated, since it may be run in under cover. A hatchway in the main floor permits the handling of goods to and from the storeroom, which is in the basement, and also permits lowering a transformer into the pit. A one-ton hoist, located on the second floor, serves the 11 kv cell room and obviates the necessity of lifting the 11 kv switches by hand. It has access to the main floor of the building through a small hatchway.

The actual placing of this substation in service occupied a period of nearly three weeks and called for no small measure of co-operation between the various company forces interested in the work. Since all the power used in San Jose and the surrounding territory had previously been carried directly from Newark substation to Station "A" at 60,000 volts, the changing over involved not only the rearrangement of the existing 11,000-volt feeder circuits, to facilitate direct service from Station "B," but also the changing of the voltage of the main line from 60,000 to 110,000 volts.

The work was carefully planned with a view to maintaining service intact. All was accomplished without interruption of service to our consumers.

Fifty-three Years a Lake Tender— The Quaint Story of Ed Roening

On October 9th last, in a San Francisco hospital, died Edward E. Roening, for fifty-three years a lake-tender in the employ of the Pacific Gas and Electric Company and its predecessors.

The story of Ed Roening is a remarkable one. His voluntary self-isolation amid the snow peaks of the Sierra Nevada for more than an average lifetime was a thing in itself almost unbelievable. Had he been a misanthrope or had he come to bury himself away from the busy haunts of man to hide some terrible remembrance or avoid the consequence of some crime, one might have understood; but there he was, a stalwart, up-standing Norwegian, full of energy, with a sense of humor, healthy and hearty; and all his mind could grasp in the way of ambition was to pass his life as he had chosen it, tramping rocks and trails and dams and spillways and ditches, breathing the fresh air of the mountains by day and enjoying the eloquent silence of the vast solitude around him by night.

Roening was a native of Norway and as a lad followed the sea. While yet in his teens he landed in California and there his sea-life ended. In one of his talks with the writer, he said he arrived in the Sierra region on the 4th of July, 1874, and stopped at Truckee awhile, moving thence to Emigrant Gap. One day he met an old farmer, who said to him: "Kid, there is a dam up there in the mountains. I am going up there with cattle. Better come along." Roening went to Cisco the next day, and in that region he stayed through the years, until youth had melted into manhood and manhood had lapsed into old age.

Lake Fordyce dam was built that year by the South Yuba Water Company. The leaders of the enterprise were James Wartenbury, an old miner who owned two-thirds of the stock, Charles Marsh, surveyor for the Southern Pacific Railroad; John Dunn, a miner; Dan Rich, originally a farmer in Ohio; T. L. Bean, a San Jose banker, who came to Webber Lake every year; and



Ed Roening at the door of his cottage at Lake Fordyce.

Captain Kidd, who operated a stern-wheel steamer on the Sacramento River. These men were all engaged in hydraulic mining and they wanted a reservoir for water storage purposes. The water from Fordyce was carried by flume down to the head of Bear Valley, where the company's main ditch rose and ran down past You-Bet mining camp, to Nevada City and Grass Valley.

The historic Meadow Lake, distant a little less than two miles from Fordyce, had flourished in early days as one of the most lively mining camps in the Sierra region. The original dam was built there in 1855 and additions thereto made in '63 and '64. The miners worked away until they found they could not save the ore from their output. It was too rebellious and needed the chlorination process, which was not to hand. The Comstock excitement started up about that time, so away they all went. "They left

everything just as if they were going away for a week-end," related Roening in conversation with the writer. "There must have been between 3,000 and 4,000 people there. The community flourished about a year and a half. They tried running a mill and found that the decomposed ore from the surface would pay, but when they got down to base ore they found nothing on the plate. There must have been about 250 claims staked out around there and they were all gone in a night."

It may be stated here that today the bed of Meadow Lake is strewn with relics of the mining days, old bottles, pans, stoves, doors and all sorts of things. They have lain there a half a century, for it has never been considered worth while to remove them.

The South Yuba Water Company's enterprise suffered a severe blow when hydraulic mining was stopped by Act of Congress. There was a period of inertia after that which lasted two or three years and until John Spaulding, an old stage driver who was superintendent of Alvinza Hayward's Virginia City mines, organized an irrigation company to take over the properties and carry water down to the fruit-growing districts around Auburn. This company also bought out the Bear River ditch, which, enlarged and reconstructed, is today a part of the "Pacific Service" system.

Ed Roening was a mine of information concerning the events of those early days. The story of the South Yuba Water Company and its successors has already been told in these columns. Roening's story did not differ in its main particulars, so it is hardly worth while to recount it at this time. How the South Yuba properties eventually came

to be a part of "Pacific Service" is a matter of comparatively recent history.

Roening had some training as a carpenter, so at first he did jobs around the construction camp, taking charge of running gear, derricks, etc. Then he was employed on the ditches between Fordyce and Grass Valley. Finally, he settled down as lake-tender, with headquarters at Fordyce. He lived in a cabin on the crest of the dam and tramped his way around the territory under his jurisdiction. This in time came to include eleven mountain lakes separated from each other by rocky trails; and from one to the other Ed Roening trudged on his two sturdy feet, the only locomotion afforded him save in the winter time, when he would strap a pair of long skis to his ankles and perform daily wonders of muscular activity over the packed snow. He said that the only bit of excitement in his life occurred when in 1905 his house on the lakeside burned down and the company built him another one on the hill overlooking the dam. One of his duties was to tramp to Cisco, nine miles over the hills, to telephone his report to his company's division headquarters; he was never known to fail. He thought nothing of tramping long distances at any time of day or night. Once the writer was at Lake Spaulding and expressed a desire to see this eccentric Norwegian. The superintendent in charge said: "I will send for him and he will be over after supper." Sure enough, Roening came and when the interview was over he set out to walk back to Fordyce, a distance of some twelve miles over the rocky trails. It was then nightfall, but that mattered nothing to Ed. He was never sick or sorry, and it was not until he was well along in middle age



The Lake Fordyce of Ed Roening's time.

that the company provided him with a companion with the title of assistant, one Gus Anderson, who lived with him twenty-three years. Anderson is now on the company's pension roll.

In the early summer of this year Roening met with his one and only accident. He fell into a spillway at Lake Van Norden, one of our company's reservoirs lying right under the Sierra summit, and fractured a bone in his hip. It was found necessary to convey him to San Francisco and to a hospital there, where he died, as many others have died under similar conditions, from pneumonia.

So passes one of the last links of humanity binding the California of today with the California of the romantic age. Of Roening's associates and superiors few, if any, live today to tell the story of the struggle for existence in those mountain wilds. Of the men who organized the South Yuba Water Company and built the first dam at Fordyce none remain on earth. Dan Rich, the real pioneer who did all the prospecting and built the first ditch in the territory, died in Nevada City about 1890. James Wartenbury died in San Francisco in the late '70's. Charles Marsh was killed in a buggy accident in San Francisco in '75. He had become a man of prominence and was the highest Freemason in the State. John Dunn died in Nevada City, and T. L. Bean died in San Jose. Captain Kidd quarreled with his partners, and when his steamboat on the river

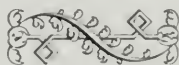


Roening's last abode on the shores of Lake Fordyce. The recent enlargement of the lake, through raising the dam, has wiped out the spot.

blew up he sold his interest to Wartenbury. He died in Stockton.

It remains only to say that Ed Roening took a great pride in himself and in his self-determined mode of life. He was proud of his acquaintanceship with the notables of early days. He told the writer how he came to know Alvinza Hayward. "He came to see me once at Fordyce. I thought he looked like an old farmer, but he was fine to talk to," said the simple Norwegian. The sum and substance of his general point of view is found in his own words at the conclusion of a somewhat lengthy historical review. "I can travel from the summit to Sacramento and everybody know me," he said.

What man, then, shall say that Ed Roening's life was an empty one? He evidently did not think so. He lived his life as he wanted to live it and that's all that need be said about it.—F. S. M.



The Story of Power in California

By A. H. MARKWART

(Continued from our July issue)

The rate structure in California, like its interconnected power system, is an evolved framework. The business of rendering electric service is monopolistic in character. Under State regulation the industry is allowed to collect its expenses of operation, maintenance, depreciation, taxes and insurance, and a return of not to exceed 8 per cent on the value of its properties devoted to the public service. There is therefore nothing available for profit, as this is commonly understood.

The rate system is built upon the regional plan. In the common good, the large cities have contributed a dense business, whereas the rural territory, upon which the cities depend, has introduced the element of diversity with attendant higher load factors. It is sometimes claimed that, in the spread of rates, the country has enjoyed the greater benefit. If this be true it must, however, be remembered that a prosperous back country is essential to a city's progress.

All rates neglect consideration of the geographical position of the consumer, although account is taken of the wholesale character of industrial usage and, to some extent, of the cost of power from other sources. Industry benefits thereby, and, in turn, there is encouraged industrial expansion in a State not yet fully developed.

On the whole, the first thought is the good of the Commonwealth and there is no direct discrimination in favor of any class of consumer. For example, the small consumer, because he is in a political majority, is not tendered an unbalanced bid for his business, so, while not wholly scientific, the rate structure at least is not political. It may be said, therefore, to rest on an equitable rather than a scientific base, meaning that it is of a character which tends to create and

preserve the material prosperity of the State as a whole.

As indicative of the extent of energy used, the production of energy per capita per year is now 1600 kilowatt hours, over two and a half times that produced per capita in the nation, and California with 3.5 per cent of the population produces 9.5 per cent of all the energy. The growth in the production of energy is now at the rate of approximately 11 per cent, compounded annually, or over three times the rate of growth of population. In contrast to this, it is interesting to note that the rate of growth for the United States is now about 9 per cent, compounded annually, or five and a half times the rate of growth of population. The observation to be made regarding the relation existing between the energy output and population growth in the two cases is to the effect that the United States is working toward that degree of power saturation which obtains in California. Were the nation saturated to the extent that California is, the rate of growth of energy in the United States would be to the order of 5 per cent, compounded annually, instead of the 9 per cent which obtains.

Among other things, the industry has succeeded in effecting the spread of electricity by co-ordinating the dense business of cities with the scattered business of country communities. With 62 per cent of the farms of the State electrified, it is demonstrated that rural electrification is economically feasible. The extension of electric facilities has encouraged decentralization of population, has synchronized the development of the city and the country, and has fostered industrial, agricultural and domestic life in sections of the State which were inactive but potential.

Future additional business of the central stations will include power to meet natural

and stimulated growth for character of uses served in territory now covered, that for present usage in territory not now covered, that required for railway electrification and that required to serve created industry. Regarding the last mentioned purpose, because of the degree of saturation which prevails it is becoming increasingly important to consider those industries which are potential users of power. To emphasize this feature, the utility companies, with a view to co-ordination in industry, co-operate closely with the business and industrial agencies of the State in studying the possibilities for creating new industry to further the State's industrial expansion and to afford employment to the many coming here to reside; for developing wider, and enriching existing markets; for increasing the consumption in California of home-produced goods, and for increasing the fabrication of finished products within the State from raw materials produced in, tributary to, or passing through the State.

The ideal living and working conditions which obtain in California, together with the contribution of the electric power indus-

try in the form of an abundance of cheap power, assure the expansion of California and its continued economic progress.

In many particulars conditions have changed since the construction of the first hydro-electric plants, with a tendency to increase capital costs. Lands and intangibles appertaining to undeveloped projects are now held at extravagant values by those with whom it is necessary to deal and in general, it is the larger and more costly projects which remain to be developed. Moreover, with greater transmission distances voltages have to be raised for economy with more expensive construction and equipment.

In addition, the Western engineer is confronted with the problem of balancing the cost of spare transmission equipment against steam reserves, and the cost of extra capacity for peaks in hydro plants and transmission as against steam plant capacity. In this connection steam plants also offer a means of meeting excessive energy demands occasioned by more rapid growth than was anticipated, as well as a means of making up seasonal and annual deficiencies of the hydro system.

California has, in effect, but two seasons, the wet and the dry, the winter or rainy season usually commencing in October and ending in April. After the first of May precipitation rarely occurs except summer showers in the high mountains. The precipitation is in the form of snow at the higher elevations of the Sierra Nevada and Cascade mountain ranges, and falls as rain in their lower foothill reaches. The run-off from the rains during the wet season and the melting snow in the dry season feed the streams of the western slope of the Sierra and the Cascades, upon which most of the power developments are situated. Elsewhere in the State the precipitation is always rain except in the northerly

Peak	% From Base	From Peak		
L.F.	%KWHR	L.F.	%KWHR	
100	65.0	100.00	0.0	.0
95	68.5	99.95	0.7	0.05
90	72.2	99.77	1.5	0.23
85	76.2	99.39	2.7	0.61
80	80.2	98.41	5.2	1.59
75	83.8	96.47	9.2	3.53
70	86.5	92.96	15.3	7.04
65	88.3	88.20	21.9	11.80
60	90.8	83.63	26.7	16.38
55	92.8	78.37	31.3	21.63
50	94.8	72.82	35.4	27.18
45	96.8	66.93	39.1	33.07
40	98.3	60.46	42.8	39.54
35	99.5	53.52	46.6	46.48
31	100	47.61	49.4	52.39
30	100	46.07	50.2	53.93
25	100	38.40	53.5	61.60
20	100	30.71	56.4	69.29
15	100	23.04	59.0	76.96
10	100	15.36	61.2	84.64
5	100	7.68	63.2	92.32
0	100	0.0	65.0	100.00

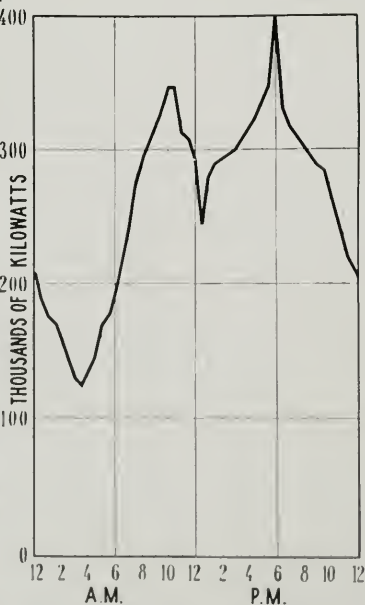


Diagram No. 1. Composite daily curve at 65 per cent load factor.

section of the Coast Range, which is favored with both snow and rain. The precipitation reduced to water varies from 3 inches on a dry year in arid sections of the State to 113 inches on a wet year in "watered" regions.

The streams of California are, in general, subject to the widest flow variations arising from its wet and dry seasons. As a result, storage of flood flows is essential to effect a monthly stream discharge more in agreement with the monthly demand for kilowatt hours. Where storage sites of sufficient capacity are not available, the plant becomes to some extent a stream flow plant and deficiencies are supplied by steam.

The California situation is further complicated by the more or less periodic occurrence of dry years with which a gamble must be taken. Practically all water power plants in California are subject to this disadvantage. The full hazard had not been grasped in California until during the past ten years, when the State experienced a number of dry years strangely enough during the period when the greatest expansion in the electric light and power industry had been made. Consequently it becomes important to consider the amount of steam power

necessary to supplement such deficiencies in the future. This and related subjects were discussed by the writer in a paper presented before the American Society of Mechanical Engineers in June, 1926.

The fact that steam plants are necessary in the long run to supplement hydro power against failure of a generating or transmission unit and to make up the deficiencies in energy, both seasonal and annual, creates a situation in which it will often be possible to install less hydro capacity to care for growth of load than would be the case were steam plants not available. This idea goes to economy in power production costs, in that it is possible to comb off a portion of the system peak with the steam plant, supplying the relatively small number of annual fuel kilowatt-hours and providing a higher load factor for the hydro, which is essential to its economy on account of the high capital costs and corresponding fixed charges which usually obtain for hydro projects. The amount of the peak that can be carried on steam to produce the best over-all economy will depend upon the system load factor, the capital cost of hydro plants including transmission, the cost of money, the cost of fuel, and the expense of operation and maintenance including depreciation.

It is a curious commentary that California started off with steam plants, that it has retained them to supplement the hydro, and that it is increasing the amount of steam power as the hydro sources are developed. While most of the power companies in California are considered hydro companies, the time may not be far off when the hydro sources will be fully developed, and fuel will again be the principal source of power, with hydro contributing as far as it can toward the sum total of energy requirements. Obviously it is desirable to generate as much water power as the conditions will allow before we make too great demand upon an exhaustible asset.

% Peak	From Base L.F.	From Base % KWHR	% Peak	From Peak L.F.	From Peak % KWHR
100	45.0	100.00	0.0	.0	400
95	47.3	99.96	0.4	0.04	
90	49.8	99.81	0.8	0.19	
85	52.6	99.59	1.3	0.41	
80	55.7	99.26	1.7	0.74	
75	59.2	98.77	2.2	1.23	
70	62.8	98.07	2.9	1.93	
65	67.0	96.96	3.9	3.04	
60	71.3	95.43	5.1	4.57	
55	76.3	93.39	6.6	6.61	
50	80.9	90.09	8.9	9.91	
45	83.7	83.70	13.3	16.30	
40	86.0	76.61	17.5	23.39	
35	88.7	69.12	21.3	30.88	
30	91.7	61.21	24.9	39.79	
25	94.7	52.75	28.3	47.25	
20	98.2	43.73	31.6	56.27	
15	100.	33.41	35.2	66.59	
10	100.	22.27	38.8	77.73	
5	100.	11.15	42.0	88.86	
0	100.	0.0	45.0	100.00	

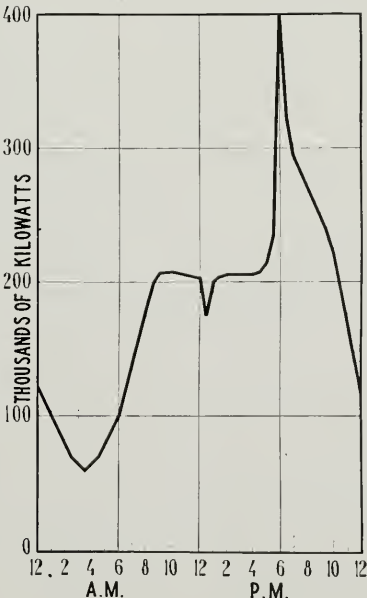


Diagram No. 2. Composite daily curve at 45 per cent load factor.

Fundamentals of Power Cost

The cost of power delivered at load centers whether in California or elsewhere depends upon the annual cost of generating plants including transmission lines. These annual costs consist of fixed interest and depreciation charges on the invested capital, operation and maintenance charges, taxes and, in the case of steam plants, fuel as well.

One of the most important fundamentals of power production cost is the relation existing between the average and the maximum rates at which power must be furnished to answer the demand. The demand fluctuates hourly, daily, weekly and monthly, with the result that the full production capacity of a plant which must be great enough to meet the maximum requirement can be utilized only over the comparatively brief period of the peak. Cost rises as this utilization ratio, or "load factor," falls.

The capital cost of steam plants at load centers with relatively short transmission, in general, is less than that of hydro plants with long transmission, resulting in lower fixed charges for steam plants. Including the cost of fuel and the relatively high running expense, however, the cost of steam-generated energy for 100 per cent load factor tends to exceed the cost of hydro-generated

energy. On the other hand, for low load factors, the cost of hydro energy tends to exceed the cost of steam, because of the greater investment for hydro unproductively employed and the savings on fuel costs for the steam. A low load factor and cheap fuel, therefore, suggest steam energy, while the reverse suggests hydro development.

For purposes of further analysis, it now becomes necessary to plot a composite daily load curve, in effect a curve showing the fluctuations of load, from hour to hour, on the average day of the entire year. This is

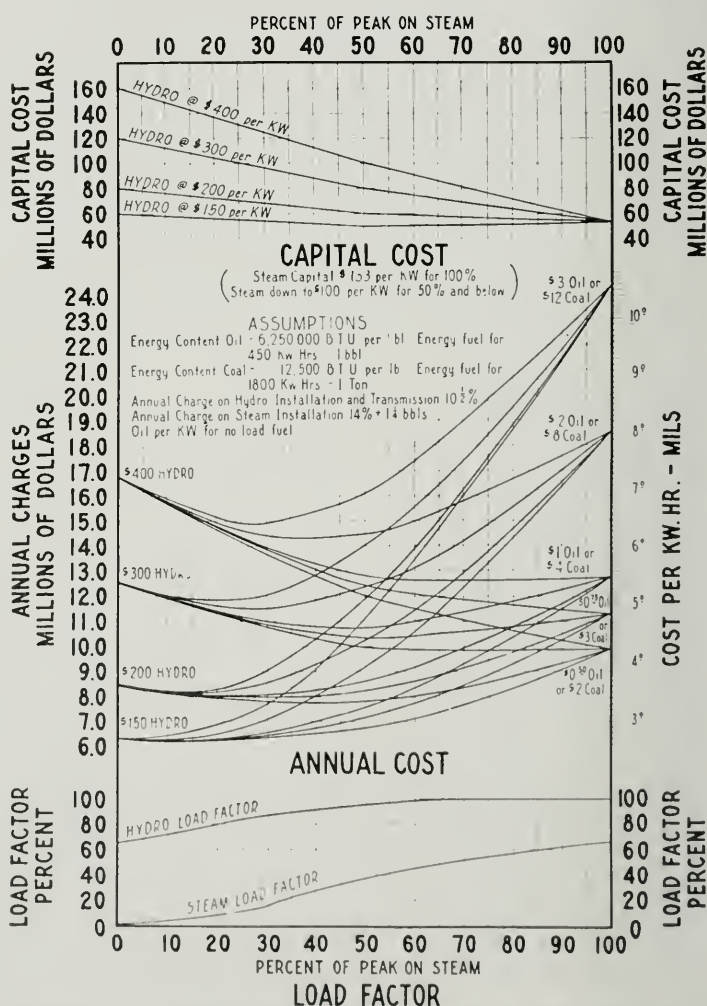


Diagram No. 3. 400,000 K.W. peak system at 65 per cent load factor.
(Hydro assumed as base load.)

shown on Diagram No. 1, the load factor of which is 65 per cent typical of a large power system with diversified load. Diagram No. 2, similarly constructed, is typical of a purely metropolitan load, with a 45 per cent factor.

Returning to the relative economy of steam and hydro under given condition, discussed above, it follows that if the total load is divided into two parts and the high load factor portion on the bottom be placed on hydro, and the low load factor portion on the top be placed on steam, a composite economy for the whole will result. The position of this dividing line to effect maximum economy has now to be determined, for various cost assumptions.

The capital cost per kilowatt of delivered peak of hydro plants varies greatly and will range from perhaps a minimum of \$150 under very favorable conditions to \$400 or more, depending largely upon storage requirements and distance of transmission.

On the other hand, the capital cost per kilowatt of delivered peak of steam plants does not vary greatly, the range being from perhaps \$85 minimum to \$125 maximum. In the remarks that follow a fixed capital cost of \$100 is assumed as a reasonable standard steam plant cost.

The annual cost of steam plants, including the cost of "no

load" fuel, but not including the cost of energy fuel, expressed as a percentage of the capital cost thereof, is almost invariably greater than the annual cost of hydro plants similarly expressed, by approximately 50 per cent.

It is therefore possible to spend 50 per cent more capital on a hydro plant to give the same annual cost of power from a steam plant at zero load factor.

As the load factor rises, thereby causing the annual cost of steam power to rise because fuel for energy is proportionately employed, the cost of hydro power may be kept equal to the cost of steam power at a given

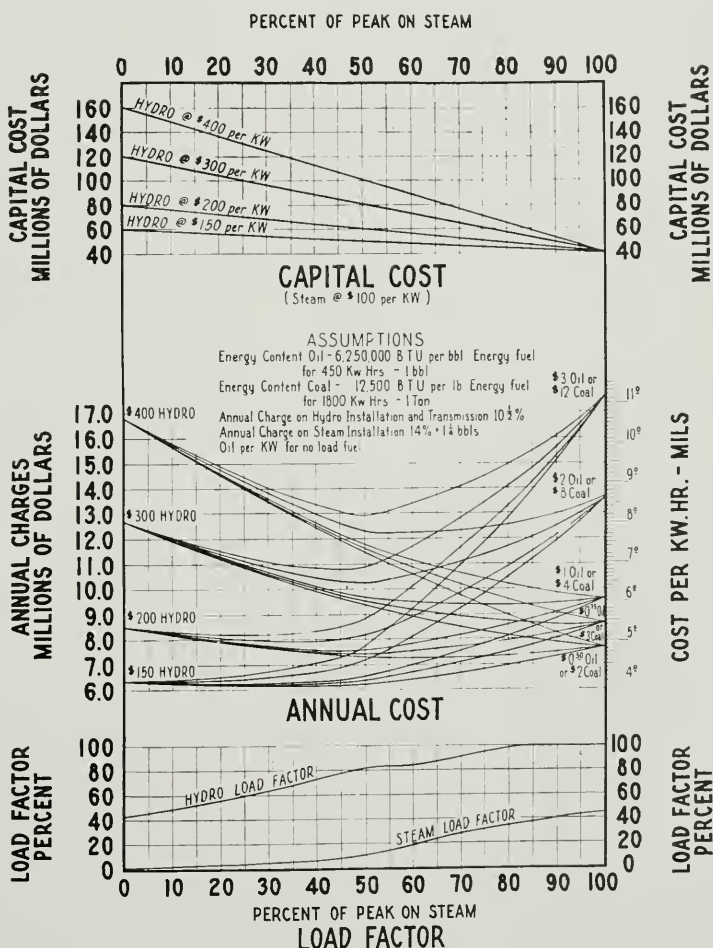


Diagram No. 4. 400,000 K.W. peak system at 45 per cent load factor. (Hydro assumed as base load.)

load factor by expending no greater amount of hydro capital per kilowatt than that which would equal the capital value of the annual cost of steam power, including the cost of all fuel, capitalized at the annual percentage cost of hydro power.

Pursuing the foregoing discussion further, the following may be stated:

(1) When primary hydro power is available to suit the system load factor, and when the capital cost of a kilowatt of hydro is less than the capital value of the annual cost of a kilowatt of steam, including the no-load fuel, but not including the energy fuel, capitalized at the annual percentage cost of a kilowatt of hydro, it will be cheaper to supply all system power from hydro developments.

(2) When the cost of a kilowatt-year of hydro power is greater than that of steam power at some load factor less than the system load factor, it often will be economic in a base load primary hydro supply to furnish the total system load from both hydro and steam, using steam on the top, and the hydro on the bottom at load factors lower and higher than the given system load factor which would respectively obtain for the steam and the hydro.

(3) When the cost of a kilowatt-year of steam power at 100 per cent load factor is less than that of hydro power, obviously steam power will always be cheaper than hydro power at any system load factor.

(4-a) When hydro power is available for peak from pondage but not for energy in an amount sufficient to meet the demand for energy at the given system load factor, and when this hydro peak can be furnished at a capital cost equal to or less than the capital value of the annual cost of equivalent steam power without energy fuel, capitalized at the annual percentage cost of the hydro plant, it will be economic in a base load steam supply to comb the system peak with such hydro power. The amount of this combining will be determined wholly by the ability of the hydro plant to furnish the kilowatt-hours required above the kilowatt load carried by the steam plant.

(4-b) If at times of the year secondary energy is available from the run-of-river flow from such a hydro plant, this energy may be employed to reduce the base load energy fuel consumption, thus producing correspondingly further economy which will permit the expenditure of additional hydro

capital amounting to the capital value of the fuel saved when capitalized at the annual percentage cost of the hydro plant.

An economic study has been made with reference to the first three of these statements as they relate particularly to conditions in California. For this purpose it was readily possible to construct a family of curves setting forth the interrelations of cost with various portions of the total load assigned to steam and hydro, for any given unit costs of steam and hydro development and fuel. (See Diagrams 3 and 4.) The curves shown were constructed specifically for a system peak of 400,000 kw. at 65 per cent and 45 per cent respectively. The 65 per cent load factor diagram indicated, for instance, that if 60 per cent of the annual peak from base is carried on hydro plants, such hydro plants will supply 83.6 per cent of the total energy required on a load factor of 90.8 per cent. If the remaining 40 per cent of the peak is carried on steam plants, the 16.4 per cent balance of total load will be supplied by steam on a 26.7 per cent load factor.

These curves indicate clearly the per cent of peak to be carried on steam for maximum combined economy. For instance, when the capital cost of hydro is \$300 per kilowatt and the cost of oil is \$2 per barrel, the cheapest way to serve the 65 per cent load factor demand is to deliver 300,000 kw. of hydro and 100,000 kw. of steam power. Under these circumstances the average cost will be 5.2 mills per kilowatt-hour. The curves at the foot of the diagram show that the hydro will operate at 84 per cent load factor and the steam at 9 per cent.

The uppermost curves indicate that \$100,000,000 of capital will be required to do this, and that the annual cost will be \$11,500,000.

The study, while perhaps not being quantitatively perfect, develops the economic certainty that at times the cost of power will be a minimum from joint steam and hydro operation, and is fairly accurate in indicating the direction in which economy lies; or, said in another way, it points out the path to maximum economy in power generation when both fuel and water power are available, although either one may be exclusively employed at a reasonable cost, or at a cost less than that obtaining with the other.

Conclusion

In concluding this narrative of the power situation in California, one may venture the opinion that the Western utilities are over-alert in looking to the extension and cost of their service. Their success is born of the success of general industry, and this will be maintained only by having power available everywhere at a cost to the ultimate consumer, which is in agreement with the most economic production feasible with the resources at hand and, at the present time, in conformity with the lowering trend in commodity and money prices; although at no time, even during the war and post-war period, has electric service had an advance in price at all in proportion with the rise in the commodity market.

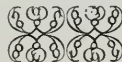
The engineer in the central station industry, to be effective in his contribution to the organized effort and team work which are essential to the progressive advance of the industry, must be gregarious and view his problem broadly, taking account not only of its technical features, but also of the economic and social elements which enter. Then will his engineering be sound in the broadest sense. Among other things, he must look to the changed situation of higher hydro and lower steam costs, to the end that there will be a continuance of an ample supply of low-priced power. The spectacular hydro development with its high-voltage transmission is justified if it produces power at a cost which is no greater than that which would obtain with steam power, or with co-ordinated water and steam power. The economy and utility of combined hydro and steam generation are being studied, for it is dependable central station power at the lowest present and future cost, as far as this latter can be determined, that is the prime objective of the engineer.

The trend of the future in the central station industry throughout the country will be the continued consolidation of diverse local markets and the further interconnection of regional power-producing facilities, in the interests of high load factor and low-priced power. With pardonable pride it

might be emphasized that the great expansion in the electrical industry on the Pacific Coast, the economies which it has realized, and the other advantages which have accrued, are the result of regional co-ordination of power demand and power supply under private initiative.

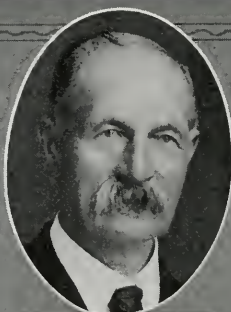
The electrical central station industry has been inspired by the pioneering spirit of the West through the presence of an abundance of hydro resource. Its continued development should proceed unchecked, though it might be through elements which now tend to oppose it. It seems that undeveloped water resources are now considered as possessing great value by individuals from whom it is necessary to acquire lands or rights to permit development and such owners consider themselves entitled to a proportion of the unearned increment of value which they believe is created by the constructive work of the power companies. There are many legal restrictions relating to the use of public lands and title in fee of such lands cannot be obtained; State and Federal licenses for use of streams for power generation are exacting; actions at law involving water rights, wasteful of time and capital, are frequent; compensation for damage, real and imaginary, is high; rights-of-way are becoming more expensive as the country develops; nuisance values are readily created, and invisible costs are mounting rapidly.

It is to be hoped that the public will not lose itself in the mystic maze of public ownership, with its consequent checking of industrial progress. The electrical industry is still young, is highly technical, and is an agency of production. Franklin said, "God gives all things to industry," but no industry, particularly the electrical industry, can advance and flourish under the weight of government ownership and operation. Public opinion should be such as will not only permit but encourage it to continue that unhampered course in the future which it has pursued in the past with such gratifying results, in the public and its own interest alike.

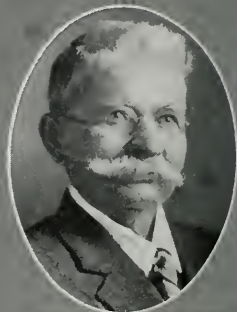




MARTIN S. NELSON



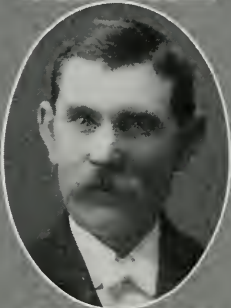
W.E. MESERVEY



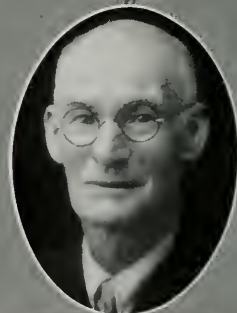
GEORGE W. KERN



C. J. PIERARD



PETER A. JACOBSON



FRANCIS H. MCKAY



G. A. WILKIE



MICHAEL STACK



ROBERT W. TITHERINGTON



THOMAS J. GODSIL

The "Pacific Service" honor roll. The above portraits are of ten former employees whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 86 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their service records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of ten portraits of our company's pensioners. These are:

W. E. Meservey. 77 years of age. Entered the service of the South Yuba Water Company October 1, 1882, and at the time of retiring on a pension March 1, 1927, was employed in Drum Division.

Martin S. Nelson. 73 years of age. Entered the service of the California Electric Light Company in October, 1886, and at the time of retiring on a pension June 1, 1927, was employed in San Francisco Division.

George W. Kern. 72 years of age. Entered the service of the Edison Light and Power Company in May, 1892, and at the time of retiring on a pension March 1, 1927, was employed in San Francisco Division.

Peter A. Jacobson. 68 years of age. Entered the service of the Northern California Power Company May 8, 1903, and at the time of retiring on a pension March 1, 1927, was employed in Shasta Division.

C. J. Pierard. 68 years of age. Entered the service of the San Francisco Gas and Electric Company January 2, 1907, and at the time of retiring on a pension January 1, 1927, was employed in North Bay Division.

Francis H. McKay. 68 years of age. Entered the service of the Northern California Power Company in November, 1909, and at the time of retiring on a pension November 1, 1926, was employed in West Side Division.

Michael Stack. 65 years of age. Entered the service of the San Francisco Gas Company in October, 1891, and at the time of retiring on a pension March 1, 1927, was employed in San Jose Division.

G. A. Wilkie. 70 years of age. Entered the service of the South Yuba Water Company on March 1, 1905, and at the time of retiring on a pension October 1, 1927, was employed in Drum Division.

Thomas J. Godsil. 55 years of age. Entered the service of the San Francisco Gas and Electric Company July 16, 1906, and at the time of retiring on a pension June 1, 1927, was employed in San Francisco Division.

Robert W. Titherington. 51 years of age. Entered the service of the Sacramento Electric, Gas and Railway Company August 21, 1903, and at the time of retiring on a pension June 1, 1927, was employed in Sacramento Division.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the first nine months of the current year. The increases in each item of revenue and expense compared with the corresponding period of 1926 are also shown:

CONSOLIDATED INCOME ACCOUNT

	9 Mos. Ended Sept. 30, 1927	Increase
Gross Operating Revenue.....	\$40,835,215	\$2,999,765
Maintenance, Operating Expenses, Rentals, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts.....	22,595,640	335,141
Net Operating Revenue	\$18,239,575	\$2,664,624
Miscellaneous Income, including Undistributed Earnings of Subsidiary Companies applicable to Pacific Gas and Electric Co.....	716,553	597,146
Total Net Income	\$18,956,128	\$3,261,770
Bond Interest and Discount	7,140,534	882,409
Balance.....	\$11,815,594	\$2,379,361
Renewals and Replacements Reserve.....	3,702,117	393,669
Balance.....	\$ 8,113,477	\$1,985,692

The foregoing statement covers only operations of Pacific Gas and Electric Company, except that the undistributed surplus of Western States Gas and Electric Company and Coast Valleys Gas and Electric Company, applicable to the Pacific Company's equity in these properties, is included in miscellaneous income. These properties were acquired as of May 1, 1927. The gross operating revenues of these subsidiaries in the five months since acquisition by the Pacific Company amounted to \$2,300,139.

The large expenditures made during recent years in both gas and electric departments in the installation of additional generating plants of large capacity and modern type, and in the improvement of transmission and distribution facilities, coupled with a season of favorable water supply, enabled the Company to transact the larger volume of business with a relatively small increase in operating expenses. Its ample resources of hydro-electric energy permitted restricting the operation of its steam plants during the greater part of this year to the minimum required to take care of peak loads and for standby purposes. The consumption of fuel oil in the electric department during recent months has consequently been unusually small.

As a result of these conditions, net income increased during the first nine months of this year by \$2,664,624. The additional capital employed resulted in increased carrying charges of \$1,790,467, and also in an increase of \$393,669 in the provision made for renewals and replacements. After the deduction of all charges and the accrual of dividends upon the outstanding preferred and common stocks, there remained a final balance of \$1,503,579. Surplus for the common stock in the first three-quarters of the year was equivalent to \$2.12 per share upon the average common outstanding during this period, or \$1.94 per share upon stock outstanding at September 30th, 1927.

The number of customers connected to the Company's distribution systems at September 30, 1927, was 955,498, including 75,750 consumers of the recently acquired Western States and Coast Valleys Companies.

SALE OF \$15,000,000 SERIES "E" 4½% BONDS

In the latter part of September, 1927, the Company disposed of an issue of \$15,000,000 par value of its First and Refunding Mortgage Series "E" 4½% Bonds. The proceeds of the sale will be utilized in retiring an outstanding issue of First and Refunding Mortgage Series "A" 7% Bonds aggregating \$10,720,000 par value, and the redemption of three smaller underlying issues, as follows:

Pacific Gas and Electric Company First and Refunding Mortgage Series "A" seven per cent bonds, redeemable on December 1st, 1927, at 110.....	\$10,720,000
Metropolitan Gas Corporation, First Mortgage five per cent bonds, redeemable on December 1st, 1927, at par.....	988,500
The Sacramento Valley Power Company First and Refunding six per cent bonds, redeemable on January 1st, 1928, at 105.....	435,000
Sacramento Electric, Gas and Railway Company First Consolidated Mortgage five per cent bonds, due November 1st, 1927.....	1,083,000

The Sacramento Electric Gas and Railway Company Bonds mature on November 1, 1927, and will be paid off at par on that date. The redemption of the remaining issues at their call prices will permit of substantial economies in annual interest charges, all of the obligations so retired bearing a higher interest rate than the bonds recently sold. The Company's capital structure will also be simplified through a reduction in the number of divisional mortgages.

The Company's excellent credit position, coupled with the strong demand for high-grade investment securities which has been evidenced during recent months, permitted the sale of the 4½% bonds upon very satisfactory terms, the cost of the new capital thus secured being the lowest in the Company's history. The new bonds were offered to investors on a 4.75% basis and were sold immediately. It is believed that this bond money is the cheapest secured by any gas or electric utility on the Pacific Coast within the past two decades.

The following statement of the Company's capitalization as of September 30, 1927, after giving effect to this refunding operation, indicates that a conservative relationship is being maintained between bonds and stock. Funded debt is equivalent to 55.5% of total outstanding securities, preferred stock 23.0% and common stock 21.5%. The Company, as for many years past, has no floating debt.

CAPITALIZATION, SEPTEMBER 30, 1927

STOCK:	Outstanding in Hands of Public
Common, paying 8% dividends.....	\$ 65,744,865
Preferred, paying 6% cumulative dividends.....	70,635,932
Total.....	\$136,380,797*
BONDS:	
First and Refunding Mortgage Gold Bonds:	
Series B, 6%, due 1941.....	20,000,000
Series C, 5½%, due 1952.....	45,000,000
Series D, 5%, due 1955.....	20,000,000
Series E, 4½%, due 1957 (this issue).....	15,000,000
General and Refunding Mortgage 5% Bonds, due 1942.....	35,785,000
Underlying and Divisional Bonds.....	34,532,000
Total.....	\$170,317,000

*Includes \$3,076,275 par value of stock subscribed for but not fully paid or issued.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE

PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY

245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII OCTOBER, 1927 No. 2

In electing Mr. A. F. Hockenbeamer to the office of president, the directors of "Pacific Service" have chosen a chief executive from within the organization.

Mr. Hockenbeamer assumes his new responsibilities with a record of active and efficient service extending over a period of twenty years. Starting with the office of comptroller he has, from time to time, assumed additional responsibilities until today he enjoys complete familiarity with the company's working organization in every department. The brief sketch of his life which appears elsewhere in this issue is eloquent in the encouragement it imparts to every young man of determination and resourcefulness who stands at the threshold of an ambitious career.

Our new president is many-sided in his grasp of the essential, whether it be in passing upon considerable contracts for the purchase of machinery and supplies or in preparing prospectus and advertisement in relation to an output of new stock. Although primarily connected with what may be called the financial arm of our company's organization, his duties as second vice-president enabled him to familiarize himself with all the major problems involved in the conduct of an efficient administration. It was, however, in dealing with the problem of finance that he made for himself a reputation that reaches from end to end of this continent. The period of financial stress that the public utilities of the country were called upon to weather shortly before the outbreak of the world war is still fresh in the memory of every publicity executive. New money was hard to obtain and the cost thereof almost prohibitive. In June, 1914, when the market for investment securities was virtually at a

standstill, Mr. Hockenbeamer conceived the idea of what is now known far and wide as customer ownership.

Before joining the company, Mr. Hockenbeamer had been in the bond business and was familiar with the technique of selling securities. He saw the possibilities, both from the standpoint of raising money and creating good-will through local ownership, of utilizing the very large mailing list of potential buyers represented in the customers' records and of marshaling the aggregate purchasing power of these people. He had already tried the idea out in a small way for a corporation in which he was interested, the California Telephone and Light Company, and felt that the results achieved there would justify the experiment on a much larger scale by the Pacific Gas and Electric Company. The company at that time had approximately 400,000 customers. Because of the machinery already in existence, all of these could be reached within two or three days with little expense beyond the cost of printing and postage.

As the company had no precedent to guide it, the departure from orthodox methods of financing was entered upon with much misgiving. This apprehension proved groundless, however, and the favorable reception accorded the new idea made it almost seem that the investing public had been waiting for it.

An issue of \$12,500,000 first preferred 6 per cent stock was offered to stockholders, consumers and employees at a price of \$82.50 a share. The idea caught on at once and the entire issue was disposed of in a very short time at a selling cost to the company of ninety-five cents a share. At that time financing through regular channels, if possible at all, could be accomplished only at the cost of \$5 or \$10 a share; so it will be seen that the success of this campaign placed not only our company but other public utilities that speedily followed its example upon an entirely new and independent financial footing.

From the day that initial campaign was started down to the present time our company has sold over its counters about \$65,000,000 worth of stock to customers and others living within its territory. The cost has been below 1 per cent, or a total saving of \$2,500,000, if 5 per cent be taken as a fair charge for selling through usual channels.

During the time the plan has been in operation the Pacific Gas and Electric Company has not changed its methods in any significant particular. This may be taken as fairly good evidence that the foundations for the initial campaign were well laid, and this has had much to do with the effective application of the new idea which since has been put in operation by public utilities throughout the country.

The story of this customer ownership campaign was told at length in an article under a San Francisco date line published in *The New York Times* in its issue of September 18th last. In this a statement by Mr. Cyrus Peirce, head of one of the leading investment houses of the Pacific Coast, was quoted. Mr. Peirce had occasion to appear as a witness before the California Railroad Commission about the time Mr. Hockenbeamer's initial experiment in customer ownership had reached a successful conclusion. Replying to a question asked by the presiding commissioner, Mr. Peirce said:

"We do not sell preferred stocks. In fact, nobody that I know of is selling preferred stocks just now. The only recent transaction of the kind I know anything about is the amazing operation of the Pacific Gas and Electric Company which has excited the wonder of the whole financial world."

Since that time our company has handled its financial problems with comparative ease. Only about a month ago an issue of \$15,000,000 of 4½ per cent bonds was sold through a syndicate headed by the National City Company of New York. This was the cheapest money ever secured by the Pacific Gas and Electric Company and, as far as recollection serves, the cheapest ever secured by any gas or electric utility on the Pacific Coast. The bonds were offered to the public on a 4.75 per cent basis and were all snapped up before the circulars had been distributed. Before the day of sale was over they had advanced a point above the offering price.

It is not surprising, then, that our new president, upon the news of his election reaching the outside world, found himself fairly smothered with letters and telegrams of sincere congratulation and expression of confidence for the success of his administration. Financial houses, manufacturers, publicity utility executives and merchants, to say nothing of public utility stockholders and personal friends in all parts of the coun-

try, all had good words to say. The public press, also, greeted the new appointment with approval. From Mr. Hockenbeamer's home town of Berkeley was issued the following editorial in the August 18th issue of *The Berkeley Gazette*:

"Well-earned recognition has come to a prominent Berkeley citizen, A. F. Hockenbeamer, with his appointment to the presidency of the Pacific Gas and Electric Company. It is particularly gratifying to residents of this city that Mr. Hockenbeamer has been chosen to fill the highest office in this great corporation, because, in spite of the demands upon his time, he has found the opportunity to participate actively in the business and social life of Berkeley. In addition to being vice-president of the Berkeley Country Club, Mr. Hockenbeamer has for years been a member of the advisory board, Berkeley branch, of the American Trust Company.

"Not only is President Hockenbeamer a genius of finance and organization, but, like the late John A. Britton, who was general manager of the P. G. & E. for many years, he possesses those human qualities that endeared the latter to every member of the organization.

"It is impossible, not always through fault of their own, for many men in high places to unbend. Engrossed in the bigger problems, they cannot find time or lack facility for the smaller contacts of life. It is not so with President Hockenbeamer. Coming up from the ranks, he has attained eminence without losing the human touch that makes for greatness of the highest order.

"Before attaining his present high place, Mr. Hockenbeamer had already made an indelible mark in the affairs of man. It was he who introduced and made possible customer ownership of public utilities which has extended throughout the corporation world. This alone has distinguished President Hockenbeamer, at the same time removing forever whatever merit there was in the argument for public ownership of all public utilities, by making possible, through thrift and ambition, for the people themselves to own and control the principal necessities of life.

"With his extraordinary talent, his background of experience and his capacity for sympathetic understanding, it is safe to predict that President Hockenbeamer's administration of the Pacific Gas and Electric

Company will be outstanding in the history of this great corporation."

Another journalistic tribute came from B. C. Forbes, publisher of *Forbes' Magazine* and a publicist of note throughout the country. In a New York dispatch to *The San Francisco Examiner* under date of October 5th, Mr. Forbes wrote:

"If you own any public utility stocks, it probably is because of A. F. Hockenbeamer. He was the genius who first conceived and operated the now almost universal plan of inducing customers, householders, to become holders of public utility stocks. He also launched employee stock ownership. P. G. & E. stockholders have increased from 3,000, when Hockenbeamer took hold, to 47,000, and 3,400 employees now are stockholders."

Another promotion noted is that of Mr. John P. Coghlan, who becomes second vice-president and assistant to the president. Mr. Coghlan entered "Pacific Service" twenty-one years ago and for sixteen years was connected with the law department as claims attorney. Five years ago the late Mr. Creed chose him for his assistant, and now he serves Mr. Hockenbeamer in similar capacity with the added dignity referred to.

Mr. D. H. Foote, third vice president, takes on the duties of treasurer as well as those of secretary. Mr. Foote is an expert in matters financial, gaining his experience in banking institutions in the East. He came to California in the beginning of the present century, and entered the public utility field in 1902 as cashier and assistant secretary to the California Gas and Electric Corporation; and when in 1905 the Pacific Gas and Electric Company was organized he became its secretary and cashier.

Mr. E. W. Hodges becomes comptroller of the company. He has been with "Pacific Service" for eleven years and is promoted from the position of general auditor. Mr. D. G. Martin becomes auditor of the company under Mr. Hodges.

Three changes are noted in the new board of directors. Mr. John J. O'Brien is president of the Byllesby Company in Chicago, and in consequence of our company's recent purchase from the Byllesby interests of the Western States Gas and Electric Company, Coast Valleys and Sierra and San Francisco Power Companies, Mr. O'Brien and Mr. Allen L. Chickering, attorney for the Byllesby interests, were asked to take positions

upon the directorate. Mr. Charles H. Dickey, elected a director to succeed the late Mr. Creed, is not only a large stockholder in "Pacific Service" but for many years has been identified with public utility corporations. For twenty years he was a director of the Consolidated Gas and Electric Company of Baltimore and was also at one time vice-president and director of the Kings County Gas Company of Brooklyn, New York. At the present time he is vice-president and director of the Southern Counties Gas Company of Los Angeles and a director of the Pacific Lighting Corporation.

Among the many activities of our Pacific Service Employees' Association the one that is proving the most beneficial is the Employees' Disability Plan.

This was the result of an investigation by a special committee of health benefit plans in operation among employers in various parts of the country. It formally came into being August 1, 1923, with a membership of 1,500, and has grown to one of 4,500. The membership is confined solely to members of P. S. E. A., and each member joining pays \$1 admission fee and a contribution of \$1 per month. The monthly contributions are deducted by the company from each member's compensation for services, so in this manner the cost of collection, usually quite an item, is eliminated.

Benefits of \$20 per week are paid, commencing on the eighth day of disability and continuing for fifteen consecutive weeks. At the end of this period no further benefits can be paid until a lapse of fifteen weeks, when if the member is still disabled benefits are resumed for another fifteen weeks. Following this second period, no further payment is made until the member has returned to and been at work for the company for a period of not less than fifteen consecutive weeks.

That the plan is financially sound is evidenced by the fact that while, during the four years that have elapsed since its inauguration, benefits amounting to \$113,858.80 have been paid to members, there has been built up a reserve fund of \$50,000.

The Employees' Association itself was organized in January, 1917, with a membership of 334. This has steadily grown until at the time of writing it stands at 7,248 members, men and women employees of our company.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 873,000 CONSUMERS OF
GAS & ELECTRICITY & WATER & STEAM
2,472,404 Total Population Served in Thirty-eight of California's Counties
CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	249	1,650,764	46	211,000	295	1,861,764
Gas	73	1,675,000	5	14,702	78	1,689,802
Water (Domestic)	18	16,000	4	11,750	22	27,750
Railway	1	105,000			1	105,000
Steam Heating	2	1,003,000			2	1,003,000

Place	Population	Place	Population	Place	Population	Place	Population
Alameda	35,140	Durham	600	Madison	300	San Carlos	1,300
Albany	6,000	Dutch Flat	400	Marzalla	100	San Francisco	708,000
Alamo	100	Dunsmuir	150	Matteca	2,000	San Jose	68,000
Alleghany	300	Eldridge	500	Manton	45	San Juan	500
Alta	100	El Cerrito	3,000	Mare Island	600	San Leandro	12,000
Alvarado	1,120	Elmira	300	Martell	100	San Lorenzo	1,000
Alviso	640	El Verano	500	Martinez	7,000	San Mateo	11,500
Amador City	750	Emeryville	5,000	Marysville	8,500	San Pablo	1,500
Anderson	1,180	Empire	250	Maxwell	600	San Quentin	3,500
Angel Island	500	Escalon	700	McArthur	167	San Rafael	7,800
Antioch	2,800	Esparto	600	Menlo Park	3,500	Santa Clara	6,500
Applegate	100	Fairfax	1,200	Meridian	250	Santa Cruz	17,500
Aptos	200	Fairfield	1,200	Millbrae	350	Santa Rosa	14,000
Arbuckle	900	Fair Oaks	500	Mills	400	Saratoga	1,300
Arcois	200	Fall River Mills	316	Mill Valley	3,500	Seaside	2,800
Asti	100	Farmington	300	Millville	250	Sebastopol	2,000
Atherton	800	Felton	300	Milpitas	400	Shawmut	100
Auburn	3,000	Finley	100	Mission San Jose	500	Shasta	46
Bangor	50	Folsom City	1,500	Modesto	17,000	Shellville	200
Banta	50	Forest City	200	Mokelumne Hill	237	Sheridan	50
Barber	500	Forestville	300	Monterey	6,900	Smartsville	300
Belvedere	750	French Gulch	170	Monte Rio	500	Soledad	475
Benicia	2,750	Fresno	72,000	Mountain Hill	1,200	Soquel	875
Ben Lomond	500	Gerber	400	Mountain View	3,000	Sonoma	1,000
Berkley	80,000	Geyersville	750	Mt. Eden	500	Sonoma	3,500
Bethany	50	Gilroy	3,700	Napa	7,000	Stockbridge	200
Biggs	750	Glen Elder	1,200	Nelsen	50	South San Francisco	6,500
Pig Oak Flat	150	Gold Run	50	Nevada City	1,800	Standard	800
Bolinas	400	Gonzales	500	Newark	1,100	Stanford University	3,652
Boyes Springs	1,000	Graton	250	Newcastle	1,250	Stanislaus	100
Brentwood	500	Grass Valley	6,000	Newman	1,850	Stockton	55,000
Broderick	800	Gridley	2,500	Niles	60	Suisun	800
Browns Valley	125	Grimes	500	Nord	1,000	Sunol	500
Burlingame	13,150	Groveland	250	Novato	2,500	Sunnyvale	2,700
Butte City	200	Guerneville	1,200	North Sacramento	2,000	Sutter City	500
Byron	400	Hammonton	300	Oakdale	25,000	Sutter Creek	1,000
Calistoga	1,500	Hayward	5,000	Oakland	600	Tahama City	200
Campbell	1,500	Hayward	3,000	Occidental	2,100	Thermalito	250
Camp Meeker	300	Hercules	600	Orland	7,000	Thornton	135
Cana	500	Hickman	40	Pacheco	300	Tiburon	500
Capitola	450	Hillsborough	1,000	Pacific Grove	5,000	Towle	50
Carmel	2,500	Hollister	4,500	Palo Alto	9,550	Tracy	4,500
Cement	1,000	Honcut	500	Paradise	600	Tres Pinos	400
Centerville	1,775	Hopland	500	Patterson	700	Tuolumne	1,500
Ceres	1,100	Hughson	625	Penn Grove	250	Turlock	5,000
Chico	12,000	Ione	1,200	Perryn	250	Upper Lake	750
Chico Vecino	2,500	Irvine	2,500	Petaluma	7,500	Vacaville	1,300
Cloverdale	1,000	Jackson	1,000	Piedmont	9,000	Valley Home	200
Colfax	800	Kennett	492	Pineole	1,000	Vallejo	22,750
College City	250	Kentfield	1,000	Pittsburg	8,500	Vina	300
Collinsville	300	Kenwood	300	Pleasanton	1,800	Vineburg	250
Colma	2,900	Keswick	20	Port Costa	990	Walnut Creek	2,500
Columbia	400	King City	1,600	Potter Valley	600	Warm Springs	300
Colusa	2,200	Kingston	100	Princeton	300	Waterford	400
Concord	4,200	Knights Ferry	200	Red Bluff	3,500	Weaverville	7,300
Copperopolis	300	Knights Landing	525	Redding	5,000	Watsonville	500
Cordelia	350	La Fayette	300	Redwood City	8,000	Wheeland	650
Corning	1,800	La Grange	300	Richmond	28,700	Williams	800
Corte Madera	1,000	Lakeport	1,250	Richvale	500	Willows	3,000
Cotati	600	Larkspur	1,000	Rio Nido	250	Windsor	600
Cottonwood	704	Lathrop	300	Rio Vista	1,100	Winters	100
Coyote	250	Lawndale	60	Ripon	1,000	Woodland	6,500
Crockett	2,500	Lewiston	100	Riverbank	1,200	Woodside	300
Crows Landing	300	Lincoln	2,000	Rocklin	700	Wyandotte	250
Daly City	6,500	Live Oak	1,000	Rodeo	900	Yolo	400
Danville	500	Lodi	3,600	Roseville	7,000	Yuba City	4,000
Davenport	500	Lodi	5,000	Rose	900	Zamora	100
Davis	1,750	Lodi Park	1,325	Sacramento	105,000	Total Cities	900
Dayton	60	Loomis	500	Salida	300	and Towns	1,983,404
Decoto	700	Los Altos	1,800	Salinas	6,500	Population	489,000
Del Monte	300	Los Gatos	4,750	San Andreas	600	Total Population	2,472,404
Denair	400	Los Molinos	460	San Anselmo	4,500	Served	
Dixon	1,200	Lytton	100	San Bruno	2,175		
Dobbsins	100						
Drytown	200						
Duncan's Mills	250						

1 marked—Electricity only.

1—Gas only.

2—Gas and Electricity.

2a—Gas, Electricity and Water.

4—Gas, Elect. and St. Railways.

5—Electricity and Water.

6—Electricity supplied through

other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.



Back of
PACIFIC GAS AND
ELECTRIC COMPANY
SECURITIES

are the resources of
NORTHERN CALIFORNIA

The Pacific Gas and Electric Company furnishes services of a nature essential to the agricultural, industrial and commercial development of the vast territory in which it operates.

In this rich and progressive field the Company serves a population of 2,400,000. Over 875,000 customers are connected to its lines.

The Company's bonds and stocks are held by 90,000 investors, every one of whom is receiving interest or dividends regularly.

The Company's Three Major
Security Issues are:

FIRST AND REFUNDING MORTGAGE
BONDS

FIRST PREFERRED STOCK (6%)

COMMON STOCK (8%)



PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



IN THE GROUNDS
AT SOUTH POWER HOUSE
ON SOUTH BATTLE CREEK

Vol
17

JANUARY 1928

No
3

PACIFIC GAS AND ELECTRIC COMPANY

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CHAS. L. BARRETT	Assistant Secretary

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W. S. YARD, Vice-President in Charge of Gas Construction and Operation
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General Counsel

F. S. MYRTLE
Editor-in-Chief Pacific Service Magazine

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		C. F. SUDAWICK	Solano District
		J. W. COONS	Yolo District
HENRY BOSTWICK	SAN FRANCISCO DIVISION		Dixon
CHAS. S. NORRHCUTT	SAN JOAQUIN DIVISION		Woodland
			San Francisco
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JOHN D. KUSTER	SAN JOSE DIVISION	W. E. ESKREW	Jackson
		CHAS. H. NOACK	Sonoma
			San Jose
G. R. MILFORD	SHASTA DIVISION	W. T. KELLOGG	Redwood City
H. B. MERYFORD	WEST SIDE DIVISION		Redding
			Red Bluff
		STEPHEN GAIN	Willow
		CHAS. HUGHES	Red Bluff District

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THE POWER-HOUSE AT INSKIP	Frontispiece
NORTHERN CALIFORNIA POWER LINK OF THE "PACIFIC SERVICE" CHAIN	F. S. Myrtle 75
"PACIFIC SERVICE" IN NEW TERRITORY— OUR NEWARK-SALINAS TOWER LINE	J. P. Jollyman 84
GAS MAKES STEADY PROGRESS ALONG THE ROAD OF INDUSTRY	J. H. Gumz 88
IMPROVED SERVICE FACILITIES FOR MARYSVILLE AND TERRITORY AROUND	93
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 98
EDITORIAL	102



Inskip power-house, on South Battle Creek, an important plant of the Northern California Power system. The installation here is of 8,043 horsepower capacity.

PACIFIC SERVICE MAGAZINE

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Northern California Power Link of the "Pacific Service" Chain

By FREDERICK S. MYRTLE

Of the numerous hydro-electric power systems that go to make up the "Pacific Service" chain that spreads its network of transmission lines over the greater part of northern and central California, not the least important is that which up to the time of its acquisition by our company was owned and operated by the Northern California Power Company, Consolidated.

This system is important from the standpoint of historical interest for two reasons; first, because it marks the earliest application of electricity to the smelting of copper and iron ores in the prolific mining regions lying north of Redding, in Shasta County; second, because through this Northern California agency was power from the Cascade Mountains in Oregon first brought over the State border line to form the great interconnection of high-tension transmission systems that stretches the length and breadth of California, from the Oregon to the Mexican border-line and from the bay of San Francisco over the Sierra Nevada range into Nevada.

It is important from the standpoint of topographical interest, for the territory there covered is one that bears signs of a tremendous volcanic upheaval in past ages, which by its copious discharge of lava has established so porous a condition of rock and soil as to create the phenomenon of underground water storage, a condition most valuable to hydro-electric power development in that the ground, holding the water like a sponge, is less affected by climatic conditions than elsewhere in the State and, as a consequence, the flow from the streams in that region is more even and dependable.

The territory occupied by the power plants, reservoirs, streams and ditches of this system lies east and southeast of Redding, in Shasta County. The principal sources of water supply are from streams

rising on and around the western slope of Mt. Lassen, a majestic sentinel that marks the southern extremity of an immense watershed, of which Mt. Shasta, a still nobler eminence standing sixty miles north of Lassen as the crow flies, guards the northern gate. In former issues of PACIFIC SERVICE MAGAZINE much has been written about the Pit River watershed, which occupies the northern portion of this 60-mile stretch. According to geologists this section of northeastern California was originally an area of low elevation, an extension of the Sacramento Valley, in fact, after the Coast range and the Sierras were formed. Then came the Cascade range extending from Washington to Oregon and into northeastern California, and whose southern line, roughly speaking, lies along the north fork of the Feather River. This Cascade range closed the gap between the Coast range and the Sierras. Marked by two sentinel peaks, Mt. Shasta and Mt. Lassen, it formed a dam or series of dams across the outlet of what was an extension of the Sacramento Valley into northeastern California. The Cascade range is essentially volcanic and is composed largely of igneous rocks which have been ejected in the form of stiff molten lava from the great belt of volcanoes, now extinct, that form the range. These mountains are very steep and exceedingly rugged, the peaks and pinnacles standing out prominently against the skyline. The lighter and more rapid flows spread out over the expanding country beyond, and in many cases formed natural dams and lakes, or filled the channels and valleys above with porous and broken lava. These immense lava beds, with their innumerable pores and caverns, now receive and store the large volumes of water which fall within the region, and provide natural and inexhaustible underground reservoirs which are replenished from year to year.



Volta power-house, on South Battle Creek. Installed capacity, 9,383 horsepower.

The geographical conditions that obtain in the Pit region are reproduced, to a considerable extent, in the Lassen country. There are no such rivers as the Pit or the McCloud there; the streams are comparatively small; nevertheless, owing to the nature of their sources, they are generally more dependable than those to be found in the Sierra Nevada region. Usually the water supply for a California power plant has to be estimated and calculated for different previous years in order to obtain any-

thing like an accurate idea of the water available for which the plant should be designed. The granite Sierra streams all require water storage to carry the stream flow through the low water season, and full draft from storage must usually be provided for about five months of the year in order to assure a supply for the low water period. Such is not the case with the streams of the Cascade range. The difference between lava and granite is just the difference between a sponge and a cup. The Northern



The settlement on the slopes at Volta power plant; there wild flowers grow in profusion and all is neat and orderly.

California Power system's water sources, then, may be said to enjoy similar natural advantages to those of our company's Pit River development, though on a minor scale.

The story of the Northern California Power Company is similar to that of every other enterprise of the kind in this country, a story of an initially modest undertaking developing gradually with the march of progress and development. It dates from the very beginning of the present century. It was, in fact, in the year 1900 that Mr. H. H. Noble, of San Francisco, conceived the idea of utilizing for power purposes a number of small ditches taking their supply from North Battle Creek and tributary streams whose principal use had been to conduct water to sawmills operating in that territory. He saw an opportunity not only to supply cities and towns of Shasta and Tehama Counties within reasonable distance for lighting purposes but, also, to interest in the use of electric energy the mining industry in the region above referred to. He knew that the Mountain Copper Company at Keswick was about to install a big smelter at that town, and he conceived the idea that it would be cheaper and better for the smelter to be operated by electricity than by steam.

His first step was to purchase from William Klotz, a sawmill man living and operating near Shingletown, his mill right, which entailed the diversion of water from Millseat Creek, in southeastern Shasta County, one of the tributaries of North Battle Creek. Next a water-right in North Battle Creek was acquired and a ditch $2\frac{1}{2}$ miles long with a carrying capacity of 75 cubic feet per second was built to discharge its flow into Millseat Creek. Then another ditch with a carrying capacity of 125 second-feet



South power-house in its canyon setting.

was built, which carried all of the accumulated flow of Millseat Creek a distance of one-half mile and discharged into a forebay reservoir. This was the beginning of the Volta power-house, which was placed in operation in 1901 with an initial installment of two 1,000-horsepower generators. Mr. Noble secured a contract to supply power to the Mountain Copper Company, and two 20,000-volt transmission lines were built, one carrying the power generated at Volta into Redding, a distance of 38 miles, and the other from Redding to Keswick, a distance of 6 miles. This was the nucleus of Mr. Noble's hydro-electric enterprise, and it bore the name of the Keswick Electric Power Company.

A third machine was installed at Volta the following year and then Mr. Noble acquired by purchase the Tehama Electric Company, which was operating a small steam electric plant near Red Bluff. A transmission line was built from Palo Cedro, a point on the Volta-Redding line 28 miles from the power plant, into Red Bluff, a distance of 30 miles. Power from the Volta system was then furnished Red Bluff and Redding for street lighting, and at that time these were the only two towns on the west side of the Sacramento Valley to enjoy this lighting privilege.

Other ditches and water sources were ac-

quired and the enterprise grew. Fresh loads were taken on, and the company resolved to build another plant. This time the company went farther north for its water supply and developed what is known as the Kilarc plant on Cow Creek, a stream that flows westward from its source near Mt. Lassen in a course almost parallel to that of Battle Creek and, like it, discharges into the Sacramento. The water rights for this were obtained from a man named Fillman, who owned the Redding Electric Company and the waterworks of that city. He operated a steam plant on the river, from which power was supplied to Redding for house-lighting purposes and for operating the pumps. The Noble enterprise purchased the steam plant also, but subsequently abandoned it. It was located on the river bank at a point where the steel bridge leading out of town toward Burney and other points crosses the Sacramento. Installation at Kilarc was of 4,000 horsepower capacity.

The Keswick Electric Power Company flourished until 1903, when its name was changed to the Northern California Power Company. Shortly after that the Northern California Power Company entered into a contract with the Bay Counties Power Com-

pany, a subsidiary of the California Gas and Electric Corporation, then operating plants at de Sabla and Centerville, on Butte Creek, to supply power wholesale to that concern at Chico. The contract there was for a maximum of 5,000 horsepower. A 60,000-volt line was built from Volta to Chico to connect with the lines of the California Gas and Electric Corporation.

Volta power-house was gradually increased to its present rating of 9,383 horsepower. The copper industry grew, and in 1905 a 20,000-volt line was built from Kilarc to mines at Bully Hill and Delamar, some thirty miles northeast of Redding. Electricity was used in the smelting of ore. Then developed a rich prospect at Kennett, and a line was built from Bully Hill to that place, sixteen miles in length. In 1906 the first power was used at Kennett for smelting the ore from the Mammoth Copper Company, the largest copper producer in Shasta for many years.

In 1907 and '08 the company's lines were extended south of Red Bluff to Hamilton City and Willows, and a contract for an additional 5,000 horsepower was made with the California Gas and Electric Corporation, the immediate predecessor of the Pacific



A side view of South power-house from the stream.

Gas and Electric Company.

A survey of water-power possibilities on South Battle Creek was made, and the result was the construction of South Power-House, with an installed generating capacity of 5,350 horsepower. This was placed in operation in July, 1909. Next came the Inskip power plant, some eight miles further down stream, with an installed generating capacity of 8000 horsepower. This was in 1910.

Meanwhile the business continued to grow and the lines from Volta to Palo Cedro and north to Kennett were changed from 20,000 to 60,000 volts. In 1908, Mr. Noble tried the experiment of smelting iron ore by electricity. For this purpose he built on the Pit River, at a place named Hercul about twelve miles from Kennett, an experi-

mental furnace, where by practical results he proved the soundness of his theory. The power demand increased, and in 1911 the largest and newest style plant of all, the Coleman plant, was built on Battle Creek, twelve miles below Inskip and a similar distance from Anderson, a point on the Southern Pacific Railroad fourteen miles south of Redding. This plant, when fully equipped,

was and is rated at 20,000 horsepower.

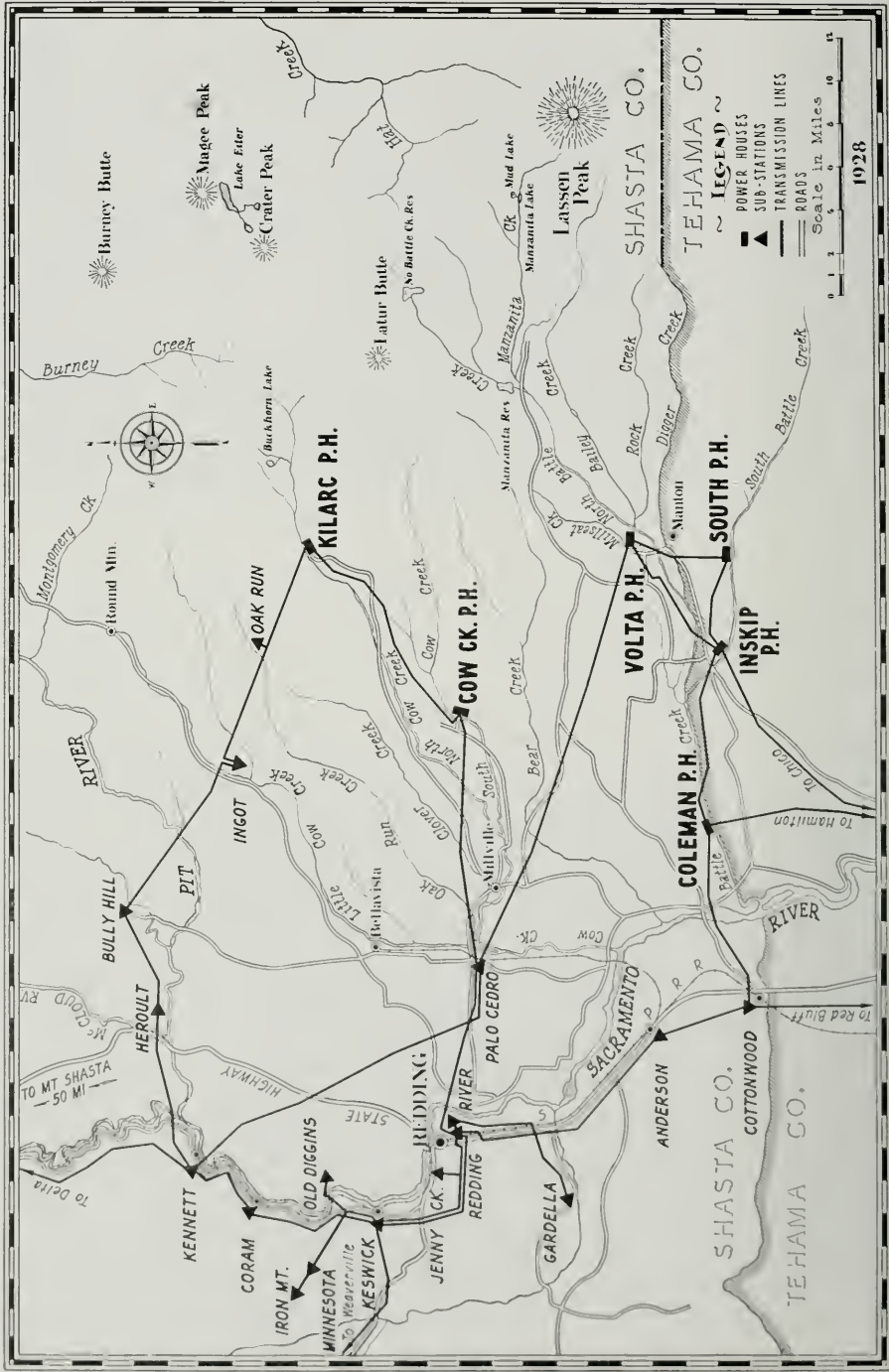
In 1912 the Northern California Power Company purchased from Mr. Al Smith, originally a sawmill operator at Shingletown, and his associates the Sacramento Valley Power Company, which was a combination of the Shasta Power Company, owning a plant on Snow Creek, and the Northern Light and Power Company, which held water-rights



A side view of Inskip power-house.



The interior of Inskip power-house.



on South Cow Creek and operated a small plant known as the Cow Creek plant. The Noble enterprise, meanwhile, had assumed the title of the Northern California Power Company, Consolidated. Its service was extended to the agricultural sections of Glenn and Butte Counties, and for some time it held exclusive sway west of the Sacramento River, its north line

for power delivery being at Kennett and its south at Dunnigan, south of Willows. Three years elapsed and then an extension was made into Trinity County for the purpose of serving a mine and dredging load. A line was built from Kennett to Weaverville, fifty miles in length, at 60,000 volts. Then, in 1917, a contract was entered into with the Western States Gas and Electric



The settlement at Inskip, with operators' cottages, offices, etc., on the banks of Battle Creek.

Company, operating a power-house at Junction City on the Trinity River, and an interconnection of systems made. The Western States Company's lines were extended from Weaverville by way of Junction City west to Eureka.

In 1911 the Northern California Power Company commenced the development of a water-right on the Pit River, above the Big



Coleman, the leading power plant of the Northern California power system. The installation here is of 20,607 horsepower capacity.

Bend, and started driving a tunnel. The Mt. Shasta Power Company also held rights adjoining those of the Northern, and litigation was imminent. These rights were eventually settled when the Pacific Gas and Electric Company in 1919 purchased the properties of the Northern California Power Company, Consolidated, having previously purchased those of the Mt. Shasta Power Company. The result of

these purchases is found today in the Pit River development, which has progressed up to the present date to the extent of power installations aggregating 235,000 horsepower capacity.

The June, 1918, number of PACIFIC SERVICE MAGAZINE contained an announcement of unusual interest to the electrical power industry in California. It was to the effect that a contract had been entered into between the Pacific Gas and Electric, Northern California and California-Oregon power



The interior of Coleman power-house.

companies, whereby through interconnection of transmission systems power would be delivered into the Pacific Gas and Electric Company's lines from the California-Oregon Power Company's plant at Copco, in the mountains of Siskiyou County, near the Oregon line, and whose sources of water supply lay in the Cascade Mountains of the northern State. At the time mentioned that company's transmission lines reached into California as far as Castella, but under this agreement these lines were to be extended

down to Kennett, in Shasta County, to join those of the Northern California. The fourteen-mile gap was closed by the building of a line from Kennett north to Delta, and thus sprang into existence an interconnection which is not only the most extensive of its kind, but has resulted in an immense benefit to power consumers on the Pacific Coast. By what may be termed a gigantic power-pool, power can be drawn from one line into another and an equal distribution maintained. This interconnection has made



Boarding-house and superintendent's residence at Coleman power plant.

for cheaper and dependable power, and has been commented upon in most favorable terms by no less an authority than Mr. Herbert Hoover who, in addressing the National Electric Light Association convention in June, 1925, said that it had worked a revolution in the direction of adequate and dependable service with economy of operation and resultant decrease of cost to the consumer.



Kilare power-house, on the north fork of Cow Creek. Installed capacity 4,021 horsepower.

The system formerly owned and operated by the Northern California Power Company, Consolidated, is well worth a visit if only for the picturesque character of its topographical features. The way in by road leads from either Redding or Red Bluff, according to choice, by way of Anderson or Cottonwood. The road across country lies through miles of rock-strewn territory, mute witness to the terrific upheaval of the long ago. In the horizon towers Mt. Lassen, the only active volcano in the United States and one which, in all probability, is today but a shadow of what it was. It is the commanding peak of the range that bears its name, but its neighbors, McGee, Latour, Butte and Brokeoff, are no mean eminences. In fact, the jagged crust of Brokeoff, similar to that of its more majestic neighbor, gives rise to the idea that may be something better than a superstition among not only the natives of that territory but, also, geologists; which is, that Lassen and Brokeoff are the edges of what was once a giant cone rising to the sky some 35,000 feet above sea-level and which one day, like Mount Pelee of recent memory, threw off its crest in one mighty explosion and wrecked the territory for miles around. This idea is given support by the fact that the earth is lava strewn for a distance of at least twenty miles in all directions.

One comes upon the streams in that territory almost unexpectedly. They flow down gorges which appear to have been cleft through the lava crust by the rushing waters. They are so favored by the spongy formation of the soil in which their sources lie that storage reservoirs have not been deemed a prime necessity. There are, however, three good storage reservoirs in North Battle Creek watershed. The oldest, Manzanita Lake, lies beneath the western slope of Mt. Lassen. It was originally a natural lake, but there is a timber dam which maintains its storage capacity. Another reservoir is North Battle Creek reservoir, lying at the head waters of that stream, and another, Lake Macomber, lying nine miles south of it.

There is an undeveloped reservoir site in the Tamarack Valley, a wide area on the head waters of Burney Creek, at the base of Mt. McGee. There is, however, no immediate prospect of this being developed.

When Burney Creek is reached, the visitor finds himself on the borders of the Pit River development territory. Our company's power lines from Hat Creek to Cottonwood, a distance of 60 miles, cross Burney Mountain, and those from the developments on the Pit River itself travel across country within a few miles of the town of Burney on their 200-mile journey to Vaca-Dixon.

"Pacific Service" in New Territory— Our Newark-Salinas Tower Line

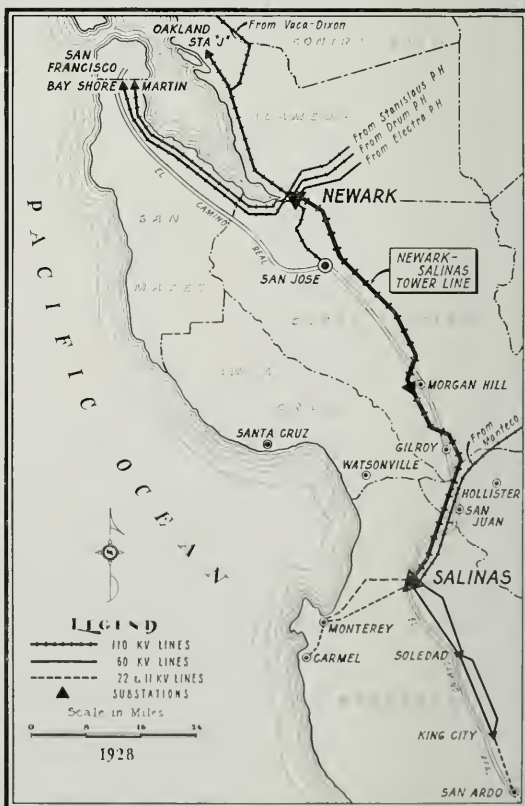
By J. P. JOLLYMAN

Chief of the Division of Hydro-electric and Transmission Engineering

The acquisition by a public service corporation like the Pacific Gas and Electric Company of new properties lying partly within, partly adjacent to the territory covered by its operations should, as a general rule, benefit consumers in the region concerned by the opportunities it affords to effect economies in operation through unification of effort, while imposing upon the corporation the responsibility of providing for the growing needs of the region. The business of carrying the entire "load" of an area justifies the establishment of service facilities superior to those which could be afforded if the utility carried only a part of the load. It follows, then, that the public is benefited by the improved service resulting.

An apt illustration of this is furnished through the recent purchase by our company of the properties of the Sierra and San Francisco Power Company and the Coast Valleys Gas and Electric Company, which constitute a part of the properties acquired from the Byllesby interests and a description of which was given in the July, 1927, issue of *PACIFIC SERVICE MAGAZINE*. The Sierra and San Francisco Power Company, in addition to service connections in the city of San Francisco and the counties of San Joaquin and Stanislaus in the upper San Joaquin Valley, has for some years past sold power at wholesale to the local distributing interests in the region south of San Jose. It delivers to the Coast Counties Gas and Electric Company for service in San Benito County, through its substation at San Juan Bautista, and to the Coast Valleys Gas and Electric Company for service in Monterey County

through a jointly owned substation at Salinas, where electric energy comes in partly at 110,000 volts from the Sierra company's main distributing substation at Manteca, in the San Joaquin Valley, partly at 60,000 volts from the company's Port Marion substation. It should be mentioned, also, that the Pacific Gas and Electric Company wholesales power to another concern, the Coast Counties Gas and Electric Company,



Map of the new territory to be served by the "Pacific Service" Newark-Salinas transmission line.



Newark substation, whence our Company's new tower line to Salinas will start on its journey.

for distribution in lower Santa Clara County by transmission to the latter's substation at Morgan Hill, and in Santa Cruz County through a line from the "Pacific Service" substation at Mountain View to its Davenport substation. It will be seen, then, that the consolidation now effected devolves upon the Pacific Gas and Electric Company the responsibility of furnishing electricity for this entire region.

From the operating standpoint the acquisition of the Sierra and San Francisco Power Company is no new thing, for its properties have been operated by "Pacific Service" under lease since January, 1920. The outright purchase of these properties, however, with those of the Coast Valleys Gas and Electric Company, presents an entirely new situation in affording an impetus to our company to proceed farther afield in its policy of keeping ahead of the public demand and of encouraging progress and development through extensions and improvements of service to the consumer.

The newly acquired territory is a region noted for its scenic beauty, its splendid natural resources and its many points of historic interest. After leaving San Jose the highway bearing the picturesque title of El Camino Real leads the traveler through the orchards of lower Santa Clara Valley to the busy

town of Morgan Hill and on to Gilroy, with its orchards, seed farms and ranches. A few miles further south the Pajaro River is reached, which is followed to the San Benito Valley. A ten-mile side trip to the west along the Pajaro River leads by way of Chittenden Pass to the apple orchards and truck gardens of the Pajaro Valley and Watsonville. Returning to the San Benito Valley, the town of San Juan Bautista, with its historic mission founded in 1797, is soon reached. A short distance to the east is Hollister, with its surrounding orchards and farms. The highway then climbs over the Gabilan range on the famous San Juan grade, once a steep and narrow road, but now a paved highway. From the summit of this a commanding view is had across the Salinas Valley to the Santa Lucia range, twenty miles to the south, and of Monterey



The Coast Counties Gas and Electric Company's substation at Morgan Hill.

Bay, first discovered by Cabrillo in 1542, nearly as far to the west. The road then descends to the Salinas Valley and the town of Salinas.

The Salinas Valley is noted for its rich soil, its sugar beets, potatoes, alfalfa and lettuce. Its agricultural area of some six hundred square miles is mostly contained between Salinas and San Ardo, sixty miles to the southeast. Below San Ardo the valley is very narrow. Near Soledad is La Soledad Mission, founded in 1791.

Twenty-two miles west of Salinas lies Monterey peninsula, with lovely Del Monte, historic Monterey and Carmel, with its picturesque setting of forest, beach and bay. San Carlos Mission, founded in 1770 at Monterey and transferred to Carmel in 1771, is the resting place of Junipero Serra, the father of the California missions. Such is the modern aspect of a region trod by the padres in their journey from lower California in the cause of God and King, to establish missions along the coast and Christianize the native Indians.

Needless to say that with the agricultural, industrial and other development of this territory the growth of demand for electric



Orchard site of the projected "Pacific Service" substation at Morgan Hill adjoins that of the existing substation.

power has been very rapid. There is need of additional service. So, to provide transmission facilities of capacity sufficient for a number of years to come our company has undertaken to construct a new 110,000-volt double-circuit steel-tower line on a private right-of-way from the company's 110,000-volt switching station at Newark through Morgan Hill to Gilroy, a distance of 45 miles. From Gilroy to Lagunita the present tower line constructed by and operated as a part of the Sierra and San Francisco system will be rebuilt, reinsulated and used as a part of the new line. From Lagunita to Salinas, a distance of eight miles, one of the existing lines will be rebuilt for use at 110,000 volts.

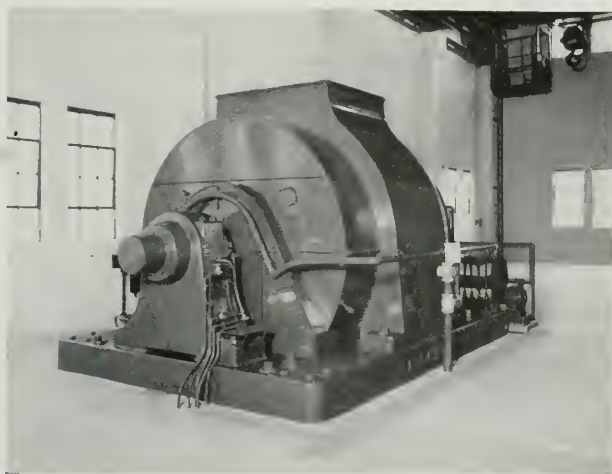


Coast Valleys Gas and Electric Company's substation at Salinas, now a part of the "Pacific Service" system.

Newark Substation was selected as the point from which the new line will be supplied because it is the central distributing point for the transmission lines from our most important hydro-electric projects. Lines from Stanislaus, Electra, Drum and the Pit power plants center at this point. Interconnections are also maintained with the steam plants in San Francisco and in Oakland.

The new tower line will follow the general route of El Camino Real as shown by the accompanying map. It will pass three miles to the east of San Jose and thence along the foot of the hills on the east side of the valley to within four miles of Morgan Hill, where it crosses to the west side of the valley. It will pass immediately to the west of Morgan Hill, thence southeast and to the east of Gilroy, where it will join the Sierra line to Salinas. The distance from Newark to Salinas is about seventy miles.

The power requirements of Morgan Hill, Gilroy and Watsonville and the country adjacent thereto will be supplied by a new substation to be erected at Morgan Hill. This substation will be equipped with transformers from 110,000 to 60,000 volts, 110,000-volt and 60,000-volt switches, and all necessary auxiliaries. Its capacity will be about 25,000 kilowatts, or 33,333 horsepower, and it will occupy a site adjacent to that of the Coast Counties Company's present station, which will be supplied with energy at 60,000 volts. In addition, the existing 60,000-volt circuit extending to Salinas and feeding the substations at San Juan and Old Mission will be supplied. As occasion may require it will also be possible to feed back toward San Jose on the existing 60,000-volt lines.



Synchronous condenser in Salinas substation. Capacity, 13,333 horsepower. A second one of similar capacity about to be installed.

In anticipation of the construction of the new tower line and to provide for the growth of load in the Coast Valleys Division, important additions are being made to Salinas substation. A second 20,000 kv-a 110,000 to 60,000 volt transformer bank and a second 10,000 kv-a synchronous condenser are being installed with all necessary auxiliaries. This substation supplies the two 60,000-volt lines that feed the Salinas Valley, the two 22,000-volt lines that feed Monterey and Carmel, and the 4,000-volt lines that supply Salinas and vicinity.

Salinas substation, as before stated, now receives power at 110,000 volts from the single-circuit Manteca-Salinas line, also from the two 60,000-volt Port Marion-Salinas circuits. The 60,000-volt lines south of Salinas feed several substations, among which is Soledad, and terminate at King City. San Ardo is fed at 11,000 volts from King City and is the most southerly point of the new "Pacific Service" territory.

Rights-of-way for the new line are now being secured. Active construction of the project will be started within a few months and will be completed by the spring of 1929.



Gas Makes Steady Progress Along the Road of Industry

By J. H. GUMZ, *Industrial Gas Engineer*

The gas industry in the United States is over one hundred years old and it has become such an integral part of our daily lives that we are liable to take it for granted, just as we take for granted the necessity for wearing clothes and living in houses. Those actively engaged in the industry have for a number of years heard a great deal about the use of gas for industrial purposes. However, the general public is probably not so familiar with such use of gas, its possibilities and, one might also say, the romance connected with it. This is largely due to the fact that the growth of the industry has been a gradual and consistent one, with nothing of the spectacular such as has attended the development of the automobile, the airplane or the electrical industry. This growth has been so great in the last few years that hardly any article with which one comes in daily contact but has felt the influence of gas somewhere between its beginning and arrival at its finished state.

Despite the fact that the gas industry is one of the oldest, if not the oldest, utility in the United States, new uses and applications are constantly being developed. One

such use, although not new, has during the past year reached a stage that has brought it to the attention of countless people to whom it is new and startling. This use is nothing other than causing refrigeration by means of a gas flame. The use of heat for producing cold is a fundamental principle which has been known for many years. The practical application of it, however, has not been easy of solution. It remained for two Swedish scientists to apply the principle of a coffee percolator to the process in such a manner that it was possible to develop a machine which had no moving parts and was entirely self-contained, and which worked continually and silently with a gas consumption per hour of less volume than was formerly used by a gas mantle light. A development such as the gas-operated refrigerator is but one indication of the possibilities for increased usage that are constantly being uncovered. And, surely there is as much romance about "Flames that Freeze" as there is about "White Coal."

Along a more commonplace line, but one that touches every home, is the use of gas by the large wholesale bakeries. Bread today

is baked in large conveyor-type ovens having a capacity of as much as six thousand loaves per hour. Another such conveyor oven was installed at the Rose Baking Company in Oakland during the past year. There are now seven such ovens using gas from the P. G. & E. Company system and together they have a total capacity for turning out 25,000 loaves of bread per hour.

Even before the flour is made into bread and baked in these gas ovens, gas plays a part in its preparation. When the wheat is



Conveyor-type bake oven, gas-fired—Rose Baking Company, Oakland

gathered from the field it passes through a harvester in which the kernels are separated from the straw and chaff. Part of the process involves the beating of the straw so that the grain will be separated from it. This beating is done by steel pins or teeth, which are mounted on cylinders which revolve at a high speed. Just as the constant dropping of water will wear

away the hardest stone, so the constant rubbing on the steel teeth will gradually wear them away. To obviate this it is desirable to obtain teeth which are exceedingly hard in that portion actually beating the grain and, on the other hand, soft and tough enough so they will stand vibration and rough usage.

The Western Harvester Company at Stockton during the past year installed a furnace for heat-treating these teeth to assure their having the desired qualities. A



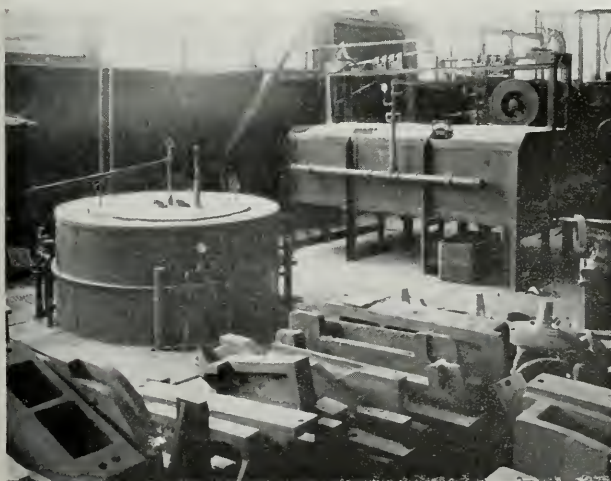
Gas-fired conveyor-type heat-treating furnaces—Western Harvester Company.

conveyor-type furnace was designed and built with gas as the heating medium. The conveyor carries the teeth through the furnace, whose only opening is a slot in the bottom through which the ends of the teeth project up into the heated interior. In this manner only the ends of the teeth which need hardening are heated.

Each tooth in its passage through the furnace receives exactly the same amount of heat as every other tooth in the two minutes it remains in the heated zone before it auto-

matically drops into water. Formerly this work was done by hand and it was possible for a man to heat-treat approximately two thousand teeth in an eight-hour day. By actual test it was found that by use of the conveyor-type furnace shown in the photograph one man could heat-treat these teeth at a rate of 1300 per hour. This is at a rate five times as great as was formerly the practice, and the resultant saving in the cost of doing the work has already more than paid for the equipment.

Another interesting use of gas at the plant of the Western Harvester Com-



Gas-carbonizing furnace and heat-treating furnaces — Western Harvester Company.

pany at Stockton is for carburizing. For certain parts of the machines manufactured at the plant it is desirable to have a very hard wearing surface and, at the same time, a piece of steel which is very tough. Ordinarily, as steel is manufactured in steel furnaces, its composition is uniform throughout and, as a rule, an extremely hard steel is also very brittle and does not withstand shock as well as a softer steel which has qualities giving toughness.

One of the elements tending to make steel hard is carbon. By heating a piece of soft steel having a relatively small amount of carbon to a temperature of approximately 1700 degrees Fahrenheit in an atmosphere of gas-containing carbon, it is found that the steel will absorb some of the carbon from the gas in a manner which will result in a skin or "case" having a high percentage of carbon and, consequently, being very hard. Penetration of this carbon rarely exceeds $\frac{1}{16}$ of an inch from the surface, so that the inner part of the steel piece remains soft and tough.

The usual procedure followed in case-hardening steel is to pack it in iron boxes containing bone char. These boxes are carefully sealed with clay and placed in furnaces



Processing fresh grape juice. Italian-Swiss Colonies.

to be heated to 1700° F. and maintained at that temperature for a number of hours. The steel then absorbs carbon from gases given off by the heated bone char. Usually this method means that a mass of material three times the weight of the steel being treated must be heated. Large furnaces are thus made necessary and the labor cost is also a very considerable item.

The Western Harvester Company built a special gas-fired circular furnace for doing their case-hardening work. The furnace contains a pot three feet in diameter and three feet deep, in which can be placed over 1000 pounds of parts to be case-hardened. Instead of packing these parts in bone char, ordinary illuminating gas is passed through the pot. It has been found that the steel will absorb carbon from this gas as readily as it will from bone char. Of course, this procedure lowers the cost of operation very materially over the old pack method, as the labor, material and fuel required are all less and, besides, the process is very simple.

California as a State has long been famous for its raisins. When an industry is successful, it is only natural that it will act as a magnet for people who see an opportunity to better their condition. The business of raising grapes has experienced this and, as a result, the acreage devoted to rais-



Thaden Metal Aircraft Corporation — gas-fired salt bath for heat-treating duraluminum.

ing grapes has been increased to a point where the production exceeds the demand. Endeavors have been made to develop additional markets for grapes and large quantities of grapes are being used in the production of grape juice. In order to comply with Federal statutes, it is necessary to treat this grape juice so that fermentation will stop. To accomplish this the juice of the grape is pasteurized in a manner similar to pasteurization of milk, which is a process familiar to all.

During the past year the Italian-Swiss Colonies in San Francisco contemplated the installation of a large steam boiler for this pasteurizing work. It was proposed to heat grape juice in batches of 100 gallons to a temperature of 120 degrees in 20 minutes. The speed at which it was planned to treat grape juice would have necessitated the operating of a steam boiler at approximately 300 pounds pressure, in order to obtain the desired temperature.

Naturally, any equipment requiring steam pressure of 300 pounds must be very substantial and costly. After a careful study of this problem, it was decided to use standard jacketed kettles, but instead of passing steam through the jackets, they were filled with oil. Gas burners placed beneath the kettles resulted in a very uniform heat which was of sufficient capacity to meet the requirements. The cost of the equipment was considerably less than would have been the case if the boiler had been installed, and the cost of operation, also, was comparable to boiler operation.

Last summer California was intensely interested in the efforts of various aviators who flew to the Hawaiian Islands. Much appeared in the press about the various types of airplanes and their construction. In fact, the entire country has suddenly



Five gas-fired metal-melting furnaces, each of 4,000 lbs. capacity. John Finn Metal Works.

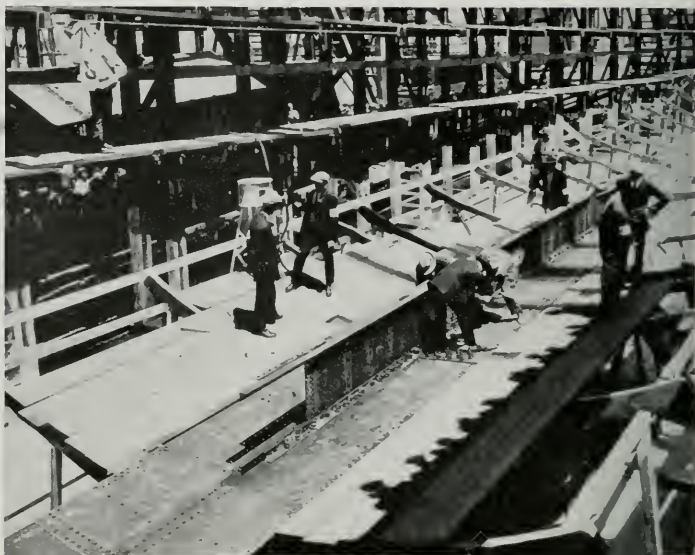
awakened to the fact that we are on the threshold of a further tremendous development in aviation. In San Francisco the Thaden Metal Aircraft Company is manufacturing an all-metal plane for commercial and private use. The advantages of this type of construction are numerous, the chief one being that all-metal construction practically eliminates fire hazard. Research has gone on for years to develop a metal which would have the lightness so necessary for heavier-than-air craft and, at the same time, the strength to withstand the tremendous strains encountered in flying. Such a metal, known as duraluminum, has been developed. A peculiarity of it is that when it is heated to 940 degrees and allowed to cool it is exceedingly ductile and can be shaped and handled as easily as an ordinary piece of tinplate. At the end of about 48 hours, however, it becomes very hard and has approximately the strength of steel.

To assure uniform heating and also to protect the metal from contact with air while at the high temperature necessary, it is heated in a mixture of potassium and sodium salts. The Thaden Metal Aircraft Company installed a gas furnace specially designed for this work. The extremely accurate temperature control necessary for this heat-treating made gas the only fuel which could be used.

As a result of the Washington Disarmament Conference practically all of the work

of building for the U. S. Navy was stopped. The work at the Navy Yard at Mare Island on the battleship *Montana* was stopped and subsequently the partially completed ship was cut up. Certain classes of ships, however, did not come under the specifications of the agreement arrived at the Washington meeting. Cruisers and submarines are in these classes, and the Navy Department is now proceeding with the construction of several ships authorized by Congress.

On the second of August, 1927, the keel of fleet submarine V-6 was laid at Mare Island. As is customary on an occasion such as this the first rivets were driven by hand by a number of the old employees in the Yard. For the first time, however, gas was used for heating the rivets at Mare Island. Tests made by the Navy Yard officials were so satisfactory that all the rivets used in the construction of the V-6 will be heated by gas. When work is begun early in 1928 on

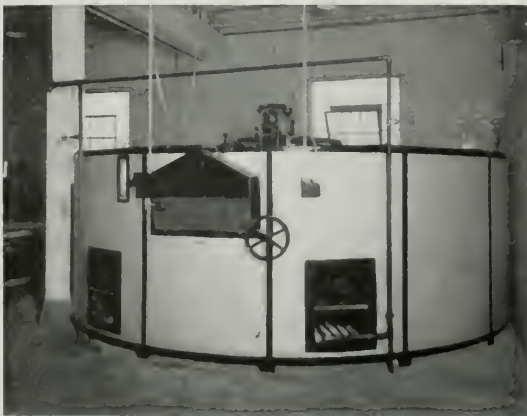


Laying the keel of fleet submarine V-6 at Mare Island Navy Yard, August 2, 1927. Gas-fired rivet-heaters were used here for the first time.

the 10,000-ton cruiser which has been authorized by Congress for building at Mare Island, the rivets will also be gas-heated.

Examination of the picture showing the keel of the submarine V-6 will give an indication of the tremendous amount of work entailed in riveting. There are literally millions of rivets in the ship, and as safety of the ship and the lives of the crew depend on its strength, it is essential that only the best processes be used. The officials at Mare Island found that the gas-fired rivet heaters gave them exactly what they wanted, not only in the way of good rivets, but also, from the standpoint of economy.

One of the products of the John Finn Metal Works in San Francisco is solder in various forms. Essentially, solder consists of a mixture of lead and tin of varying proportions, depending upon what it is used for. Tin used in its manufacture costs over 50 cents a pound, and large losses could easily occur if the metal should be overheated and the tin lost through oxidation. The complete control of gas heat decided the Finn Metal Works to install it for five furnaces, each of 4,000 lbs. melting capacity.



Gas-fired baking oven, Rose Baking Company, Oakland

Improved Service Facilities for Marysville and Territory Around

Recent extensions and improvements of service facilities in and around the time-honored city of Marysville, present headquarters of our company's Colgate Division, bear eloquent testimony to the march of progress in that city and the surrounding territory, particularly in agricultural and industrial expansion.

The division now boasts of a new headquarters building to take the place of the old office in the Ellis block, on "D" Street, near the highway bridge. The new building is located on the southwest corner of Sixth and "E" Streets, a broad, pleasant thoroughfare about two blocks from the new Marysville Hotel. It is a modern, two-story, mezzanine and basement structure, the exterior of brick and terra cotta, with a modified Spanish treatment expressed in the cornice and window design, together with a coping of variegated green glazed terra-cotta tile. The pressed brick is rug-textured, ranging in color from straw to red and laid in red mortar with raked joints. The marquise over the entrance and the window sash and trim are all finished in verd antique. The awnings have colored stripes, green and brown.

On the ground floor are located the public lobby and management offices. In the lobby an island counter is provided to facilitate the transaction of the largest portion of the business having to do with the public, namely, the handling of service applications and the payment of bills. At a second counter care is taken of such business as may

require special investigation, and here may be secured general information and sales data. This arrangement prevents congestion and provides a certain amount of privacy when desirable. The rear portion of the first floor is utilized as work space for the registry department, telephone exchange and addressograph operations.

The walls of the lobby are plain and finished to imitate travertine stone. Enrichment is secured by color and texture and by the jointing of the travertine, which is a warm grey. The ceiling treatment is a modified Spanish stipple in old ivory, with a plain membered cornice. The same materials are used in the management offices except that here the walls are finished in a brocade texture and the ceiling in a sponge stipple. The woodwork of the lobby and management offices, including the balustrade of the mezzanine floor, is of Philippine mahogany. The floor is of cement, chemically colored in browns and greens and marked off to imitate tile.

The large plate glass show windows on both street fronts and the one on the side



New "Pacific Service" headquarters at Marysville, Sixth and "E" Streets.

give ample opportunity for display purposes. Suitable equipment has been installed to provide for the demonstration of both electric and gas appliances, such as space and water heaters, refrigerators, stoves and other gas and electrical appliances. A battery of reflectors and flood lights can be operated to give many lighting effects desired in display lighting.

On the mezzanine floor are located the ladies' rest and lunch rooms, equipped with kitchen, cloak room and lavatory. The sales department occupies the space overlooking the lobby, and has sufficient space here for secondary display purposes. The collection department is also on this floor.

The second floor is loft space, divided about equally between the accounting de-



The office on the main floor, Marysville headquarters building.

partment and the engineering department.

In the basement are located the heating and ventilating plant, a vault and general storage space. The ventilation of the building is accomplished by a system that completely changes the air in the work areas with washed air six times per hour. During the hot weather months the air is cooled from ten to fifteen degrees below the outside temperature.

During the cold weather months the air taken in by the ventilating system is passed through steam-heated coils which heat the air to any desired temperature. These coils receive their steam from a gas-fired, low-pressure boiler.

The interior of the building is flooded with artificial illumination, using electric fixtures mainly of the semi-indirect type, simple in



Marysville substation, recently reconstructed.

design but effective in their setting and efficient in operation.

The telephone facilities consist of a duplicate system of wiring, one connected to the Pacific Telephone and Telegraph Company's system, the other to the private lines of "Pacific Service." The controlling switchboards for the building are operated by one operator and are situated in a small room especially constructed for this purpose. A call system has also been provided so that certain persons can be called without the use of the telephone, thus relieving the congestion on the switchboards.

Provision has been made for reasonable future growth within the building; also for additional building structure when that may become necessary. The yard space in the rear will be used for auto parking. The area on the south side, which is the main approach to the building, has been laid out in a garden with a flagpole in the center. The front portion of this area is paved in a red cement finish and furnished with a cement bench and pots, and a drinking fountain for the public's comfort. The building was opened for business January 1, this year.

Considerable reconstruction work has been done at Marysville substation, which was originally built in 1906 for the joint purpose of switching the 60,000-volt lines coming in from the de Sabla, Centerville and Colgate hydro-electric plants and fur-



Outdoor switches, Marysville substation.

nishing power at distribution voltage to Marysville and the surrounding country. At this station 4,000 horsepower of electric energy was transformed from 60,000 volts to 11,000 volts, and a like amount of power is changed to 4,000 volts. The 11,000-volt delivery is transmitted to many rural consumers, while the 4,000-volt delivery is used to carry the city load. A portion of the 4,000-

volt power is also used for railway purposes by means of rotary converters, which change and reduce the 4,000 volts power from alternating current to 600 volts direct current. This power is used on the main line of the Sacramento Northern Railway and, also, on the street car lines.

Until quite recently, when major improvements were made to this substation, practically all of the



Exterior view of Marysville gas works.

electrical facilities were of the dry-type. With the increase in power demands and change in design of electrical apparatus it was found advisable to place outdoors all of the 90,000-volt equipment, consisting of oil circuit breakers, transformers and bus work. In order to make room for the outdoor reconstruction it was necessary to utilize a portion of the adjoining property used by the Gas Department, which involved the complete removal of a gas holder and gasifying apparatus and the moving of a reaction frame water tank to a new location.

The presence of the tower on the river side of the station made it impossible to take the 90,000-volt circuits out underground. This necessitated the construction of an overhead 11,000-volt dead-end structure of sufficient height to pass the wires over the tower.

Inside the substation building, the bus main of the old high-voltage gallery for installing 4,000-watt distribution benders, oil pumps and the space between the gallery, formerly occupied by the transformers, was used for isolation voltage equipment for the 4,000-watt benders. Prior to the reconstruction of the station all distribution benders were taken out of the building overhead and were placed in a pipe structure immediately outside of the station. This structure has recently changed and constituted a distribution layout. In the rearrangement of the station the method of routing the benders was changed and of 4,000-watt and 90,000-volt lines were taken out underground.

Improvements in the 90,000-volt railway service consist of installing a single 700-kw power generator across the 70-kw railway connection of the lower river.

In connection with the growth of about "half" which necessitated this reconstruction work, it is of interest to note that the location of the south and west of Marysville



The river at Marysville gas works.

has also made a fine record in the use of power. This is abundantly demonstrated by the output of power from Shasta substation, which was built in 1900 with a capacity of 1,500 kw. This was increased to 2,000 kw, and last year further increased to 4,000 kw. Appraisal has now been given to construct an additional station at this location near Tule, which will deliver an initial output of 3,000 kw, or approximately 4,000 horse-power.

The reconstruction work done at Marysville Gas Works was described at length in the April, 1927, issue of *Pacific Service Magazine*. This concerned mainly the removal of the output power of manufacturing. Marysville was the third city in the State to introduce illuminating gas, the Marysville Coal and Gas Company having been incorporated on May 15, 1898. Coal gas was manufactured in 1901, and now, at this late date, output has come back into use. The new installation, which is now a little more than a year old, has increased the capacity of the gas works from 1,000,000 to 1,200,000 cubic feet per day. Following our company's policy of serving outside business by high-pressure lines, central manufacturing plants, the city of Oroville was supplied gas from the Marysville Works, and a high-pressure line is now being constructed to Chico.

Marysville is the chief city of Yuba and Sutter Counties and is known as "The Hub of the Sacramento Valley." Its picturesque history reaches back to the gold mining days

of 49, when it was known as "Yubaville," the name being changed to "Marysville" in honor of Mrs. Mary Covillard, the first white woman resident. In early days the city was the mercantile distributing center for the Sierra mining district nearby, with 36 stage lines finding a terminus there, and several steamship lines running to San Francisco. In a single year, in the early fifties, as much as \$12,000,000 in gold was shipped from Marysville by a single firm of gold buyers.

Gold mining has been a continuous factor of Marysville's development. The Yuba Manufacturing Company today is world-famous as the maker of enormous gold dredges; while at Hammonton, nearby, many dredges continue to extract the gold from the gravel deposits, the largest gold dredges in the world being at work here. Yuba County is the leading gold-producing section of the United States.

But Marysville has grown and prospered even more by agriculture than by mining. In early days it was the center of the stock-raising industry; then wheat fields were planted and stretched for many miles around, the golden grain being reaped, threshed and sacked by great "combined harvesters"; today a diversified and highly intensive agricultural development finds its center here.

Here originated the greatest canning peach in the world, the Phillips Cling, which supplies half of all the cling peaches canned in the United States. The Thompson seedless grape was propagated in Summit County, and now covers tens of thousands of acres.

The largest pear orchard in the world covers 350 acres of land in the rich river bottom along the Feather River in Yuba County. Olives and figs grow wonderfully there, while rice, alfalfa, vegetables and an almost unlimited list of other crops are raised in profusion.

This agricultural development, while a matter of long-continued growth, has expanded enormously within the past ten years, largely due to irrigation by electric-driven pumps and to scientific cultural methods.

Pacific Gas and Electric Company has borne an important part in the development of the territory surrounding Marysville, not only in its agricultural development, but also in the growth of mining and industry. This company generates electric power at the great Colgate plant, of 20,000 horsepower

capacity, located in Yuba County on the Yuba River, the transmission lines from this plant and interconnecting lines from other plants of the P. G. & E. System forming a network in the territory around Marysville and making possible the supply of cheap, abundant electric power to all the community. The Hammonton dredges are supplied with current from these lines, also the Sacramento Northern Railway, the cities of Marysville, Yuba City, Colusa, Oroville, Wheatland, and the great group of rural consumers.

Our company early undertook to study and stimulate the use of electricity for agricultural purposes; and many will recall the "Electricity on the Farm" demonstration car which the company maintained on the (then) Northern Electric Railway as early as 1911, and which was sent to all the towns in the Sacramento Valley.

The extent of agricultural development around Marysville may be appreciated by the fact that in the Colgate Division of the company, reporting through the Marysville office, the total horsepower of connected agricultural motors is now 41,357. At the end of 1919, the connected agricultural load was only 20,600 horsepower, showing that the agricultural business has more than doubled in the past eight years, indicating a most satisfactory growth.

Other indications of the rapid growth of the community in the use of electricity are revealed by the fact that the number of electric consumers whose accounts are handled through Marysville doubled in the last eight years; the miles of electric lines in the division doubled in the last eight years and now stand at 1,318 miles; while the deliveries of electric energy through the Marysville substation more than doubled in the same period.

Nor has the activity in the gas department of the company lagged behind; for the sale of gas through Marysville office has considerably more than doubled in the last eight years, with an increase of consumers of more than 60 per cent. The mileage of gas mains has also more than doubled in the same period and now stands at 81 miles.

The increase in load and consumers of Pacific Gas and Electric Company serves as an index of the growth of the community as a whole, rural and city. The city of Marysville itself is growing steadily in population, being about 10,000 at present, with a growth of over 50 per cent in the last ten years.

The Financial Side of "Pacific Service"

Messrs. Haskins & Sells, the Company's independent auditors, have not yet completed their annual audit of its accounts for the year 1927. Our earnings statement and balance sheet are not, therefore, available for publication at the time of going to press, but will be presented to stockholders at the annual meeting on April 10, 1928, and will be published in full in the April issue of the magazine.

COMPANY'S STANDING FROM AN EASTERN VIEWPOINT

The following excerpts from an analysis of the Company's operations which appeared in a recent issue of the *Boston Commercial*, a long-established and conservative financial journal, will, it is believed, be of interest to our readers:

"By all odds one of the fastest growing, most efficient and best earning of the large public utility concerns of the country is Pacific Gas & Electric, incorporated in October of 1905, at which time it acquired the stock of California Gas & Electric and San Francisco Gas & Electric. * * * *

"The expansion which has come to the company during the past twenty-two years, as well as the substantial and steady increase in its earning power and the growth of the equities back of its various outstanding securities have all combined to give them a high investment rating, not only with the general public, but with thousands of the company's customers. Both bonds and stock issues have proved a very desirable form of commitment by the investor seeking a fairly liberal yield combined with ample security. * * * *

"As is to be expected in the case of the securities of a company so well established and dominant in its field as Pacific Gas & Electric, prices are such as to return relatively conservative yields. Thus the general and refunding 5s of 1942 are quoted about 103½ to return slightly over 4.6% on a yield basis. The first and refunding 4½s, series E of 1957, are quoted approximately at par. Interest and service charges on the outstanding funded debt have been covered by the company regularly over a long period with a considerable margin of safety. Earnings for the shares have also been large. In comparison to the size of the properties and their value, as well as demonstrated earning power, capitalization is extremely conservative and moreover capital structure is so divided as between bonds, preferred and common stock as to render it economically sound. * * * *

"Operations are highly efficient since plants and electrical equipment are modern in every respect. Ordinarily the company's operating ratio does not run higher than 61%, and in years of favorable water supply averages 60%. This figure is to be considered as evidence of the company's operating efficiency, inasmuch as it is not only a hydro-electric utility but one of the leading gas companies of the country. Reserves for depreciation and obsolescence of equipment have been liberal over a long period, and properties are maintained at concert operating pitch. Such reserves have averaged well in excess of those usually allowed by public utility companies. Only about 1% of the company's electric output is generated by steam today, the other 99% being from hydro-electric equipment. This is a unique position.

"Pacific Gas & Electric is now the largest company of its kind in the western half of the United States. It supplies a variety of utility service to the north and central portion of California, although the bulk of its revenues, or about 97%, is from electric and gas operations. Of this total 62% of income is derived from electric sales and 35% from gas. Customers served by the company have increased greatly in all recent years. The outlook is for continued steady expansion.

"The company's securities are to be regarded as among the most desirable forms of investment available, regardless of type."

RECLASSIFICATION OF CAPITAL STOCK, AND INCREASE IN AUTHORIZED CAPITALIZATION

A special meeting of the stockholders of the Pacific Gas and Electric Company was held on February 13th, 1928, for the purpose of authorizing an increase in the Company's nominal, or authorized stock capitalization. Prior to this meeting the authorized capitalization consisted of \$80,000,000 par value 6% First Preferred Stock and \$80,000,000 par value of Common Stock.

The previously authorized limit of \$160,000,000 was established in May, 1911. In the sixteen and one-half years which have elapsed since that time the Company's gross business has quadrupled, and stock issues have been put out from year to year after hearings before the Railroad Commission and with its authorization, for the purpose of meeting the cost of additional facilities to meet the public demand, until the outstanding stocks now in the hands of approximately 50,000 investors have practically exhausted the old authorization. During this same period, capital expenditures have aggregated close to 200 million dollars, of which one hundred and six million fell in the last five years, sixty-three million in the preceding five, and thirty-one million in the remaining six years. This illustrates that, as the Company grows in size, its needs for new capital expand in a geometrical rather than an arithmetical ratio.

Having this in mind, and also in the belief that the development of the manufacturing, commercial, agricultural and other resources of Northern and Central California will, over a series of years, proceed at an even greater rate than in the past, the Company's directors recommended to the stockholders an increase of \$240,000,000 in the nominal share capital, which, including the previous authorization, brings the total up to \$400,000,000, subdivided as follows:

6%	First Preferred Stock.....	\$140,000,000
5½%	“ “ “	40,000,000
5%	“ “ “	20,000,000
	Common Stock	200,000,000

This action was largely a matter of corporate routine, no unusual or immediate stock issues being contemplated. Such issues as may be put out from year to year will, of course, have to be submitted to the Railroad Commission and under the law must be limited in their purposes to additions, betterments, improvements and the refunding of existing obligations.

The new classification includes, in addition to the present First Preferred 6% Stock, two new classes of First Preferred Stock bearing dividend rates of 5½% and 5%, respectively. With the exception of the dividend rates, they all have the same terms and preferences as the 6% stock. The present 6% stock, largely because of the reason that the Company within recent years has done a considerable proportion of its new financing with common stock, thus creating additional equities for its preferred stock, has for some time commanded a price in the open market well above its par value. There is a very noticeable tendency for sound utility preferred stocks to sell at yields not far from those returned by good bonds, and the creation of these 5½% and 5% preferred stock classes will enable the Company to adapt its future offerings more nearly to investment market conditions.

THE OUTLOOK FOR CALIFORNIA GAS AND ELECTRIC UTILITIES

By A. F. HOCKENBEAMER

President, Pacific Gas and Electric Company

The gas and electric utilities of California enter the year 1928 with an ample supply of power for home, farm and factory and with gas works fully equipped to meet the ever-continuing growth of cities and towns. They have today, awaiting buyers, more kilowatt-hours on their shelves, figuratively speaking, than at any time in their history. On their financial side credit was never better. Their stocks were never in greater demand nor more widely owned. Their bonds never commanded a higher price in the financial markets. Money on good terms is available for whatever expansion may be ahead and for refinancing old obligations where they can be retired with advantage.

However, it is not to be expected that the general building programs of the utilities will equal those of some recent peak years, especially in the period of 1920 to 1925. Those were years of unusual construction activity to catch up with work necessarily postponed during the war, or stimulated by the unusual business expansion which followed the war. By 1926 the utilities of California were back to normal. In the year just closed their record was likewise one of normal activity, of consolidation and co-ordination and of welding together existing properties. Several mergers of smaller companies into larger companies were brought about and each of these was in the interest of economy and efficiency. One example affecting only the one item of management costs may be cited: The Pacific Gas and Electric Company, within a comparatively few years, has, through the abolition of the separate management staffs of fourteen smaller companies acquired by it, saved for the benefit of its consumers enough to more than equal the total of the salaries at present paid to its own entire executive and management staff, and this staff is responsible for the operation of one of the largest public utilities in America.

Economies and efficiencies in operation were the goal of the utilities in 1927. The leading companies showed remarkable results and closed the year with excellent operating records. Economies and efficiencies enforced in 1927 were reflected in the rates charged to consumers. There were many rate adjustments during the year, and in some instances reductions of importance. This was especially true of electric rates. In some sections of the State reductions in lighting rates were as great as ten per cent. Additional reductions may be anticipated. Aside from the changes and reductions of the year, it is worthy of note that gas and electric rates kept below the price level of other commodities. Reports of the Department of Labor show that the cost of living in San Francisco is still approximately 60 per cent above the pre-war level and in other parts of the State it is even higher. Contrasted with this, gas and electric rates are no higher than in 1914. In many instances they are lower.

Reports covering the entire State show that 120,000 electric horsepower were brought in during the year 1927. Additions to steam power totaled 32,000 horsepower. The plans for 1928 call for the beginning, prosecution of or completion of projects footing up more than a half million horsepower. Of this, approximately one-half will be developed in hydro-electric generating stations on various rivers and streams in California and the remaining half in steam plants. In this connection it is interesting to note that increased fuel, boiler and generator efficiencies have definitely placed steam generation of electric energy in competition with many water powers which, only a few years ago, might have been deemed economically feasible. It is not unlikely that the year 1928 will mark the beginning of a series of years in which steam will assume here, as it has assumed elsewhere, an increasingly larger role in electric development.

In the gas industry there has been a further development of long-distance transmission of artificial gas. This development, within the narrower limits imposed by physical conditions, parallels in a measure and has much the same economic basis as the more familiar practice of interconnecting electric systems. Northern California, for example, now boasts of continuous gas transmission lines from San Francisco to San Jose, from San Rafael to Santa Rosa, and from Marysville to Oroville and Chico. By this means the cost of producing gas has been cheapened by concentrating its manufacture at the larger and more favorably situated plants and abandoning smaller and less efficient plants. It has also broadened the market for artificial gas by making it available in communities not of sufficient size to support isolated plants.

In Southern California long-distance transmission of natural gas is well established. There 1927 saw the distribution of natural gas so well organized that artificial gas was almost entirely displaced. Until 1927 there was a tendency to use natural gas for industrial rather than domestic service, but the year ends with natural gas as much a part of the domestic life of that section as was artificial gas ten years ago.

It is expected that 1928 will be marked by the development of additional business along existing facilities, both gas and electric, rather than by extensions into new territory. This follows from the fact that gas mains now cover all the important cities and towns in California and electric lines run along every road and highway. As the cities and towns grow, additional demands will be made upon the existing facilities. More homes and more factories will be connected with the gas mains now laid and with electric lines now available. New and additional uses in homes and factories will add still further business.

Few realize how thoroughly California is now served with gas and electricity. All the important cities and towns in the State have gas service, either from local plants or from transmission lines connecting the larger cities. Many mains extend into the country, and the Pacific Gas and Electric Company alone has 13,471 gas consumers living outside of incorporated territory. As for electricity, there is not only service in every town but along remote roads and byways. At the present time more than 62,000 farms in California use light and power. This is 45 per cent of all the farms in the State. With such a showing it is hardly necessary to add that in the use of electricity on the farm California leads all the States of the Union.

Dependable electric service in large volume is no longer confined to the cities. It is to be had wherever there are lines. Shops and factories are spreading out into small towns and even into the country itself. Cheap and abundant power makes it possible for manufacturers to locate on land less costly than in the cities and gives employees of these factories the benefits of country life with the comforts and advantages of the city.

The downward tendency of interest rates, which continued throughout 1927, encouraged considerable refinancing among California utilities. Such refinancing brought cheaper money to the utilities and added to their stability. Securities of the leading companies were in great demand and rose steadily in value, and when 1927 came to an end commanded higher prices than ever before in their history.

The utilities of California face 1928 with conservative optimism. They foresee a continuation of the steady growth that marked their progress in 1927, perhaps a greater growth in the use of the existing facilities by existing consumers. Active sales campaigns will be carried on by the leading companies, and 1928 should end with a substantial increase in the per capita use of gas and electricity.

It has become the habit in some quarters to speak of presidential years as unsettled. Insofar as the utilities of California are concerned, they have no reason to fear such years. The last two presidential years, 1920 and 1924, witnessed as large a growth as in other years, and the Pacific Gas and Electric Company actually had in those years a larger annual growth than in any other time in its history. This may be merely a coincidence, but even at that it may be regarded as seriously as the tradition that presidential campaigns must of necessity hamper business. We look forward to 1928 in the confident expectation that it will be a year of sound growth and development in our industry.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE

PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY

245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII JANUARY, 1928 No. 3

Once more we look in retrospect upon a year of labor in the public service and note its record of accomplishment and progress. Then, putting that record behind us, we are prepared to assume the responsibilities of another twelvemonth, with all it will entail in the way of new construction work and maintenance of adequate service facilities, a never-ending task which devolves upon every public utility in these days of growing population and its attendants of commercial, agricultural and industrial expansion.

The "Pacific Service" record for 1927 contains some noteworthy features. A decisive step in the direction of a much-to-be-desired co-operation between power and agriculture was taken when the Melones power-plant, on the Stanislaus River below Melones dam, was placed in operation last June. Our readers are by this time familiar with the facts and circumstances which lead to the construction of this new addition to our company's electric generating and distributing resources. Suffice it to say here that the water for operation of this plant is taken from the Melones dam constructed and operated by the Oakdale and South San Joaquin Irrigation Districts, and that our company pays the districts for use of this water a sufficient amount per annum not only to pay interest on their water bonds but, also, to amortize the entire issue within a period of 40 years. This co-operative agreement between the power interests and the irrigationists has been commented upon most favorably and may be regarded as the forerunner of many more such undertakings in other parts of the State.

In the Pit River region, the diversion dam at Pit No. 4 development was completed in the early summer and is now rendering good service in regulating stream flow on the

river against any inequalities in demand upon the upstream plants, notably Pit Nos. 1 and 3. In the Sierra Nevada, the work of raising Lake Fordyce, the parent reservoir of our company's Spaulding-Drum system, was accomplished. By elevating that structure 47 feet the reservoir has been increased from 20,000 to 46,662 acre-feet capacity, making Fordyce the second largest reservoir in the company's system. The result of this reconstruction work in the higher levels near the Sierra Nevada summit will be not only to place at the disposal of our company's electric users many millions of additional kilowatt hours of electric energy, but, also, to augment the supply of water for irrigation of the deciduous fruit lands in lower Placer County during the arid months of the year. As a part of the same enterprise, work was started on the enlargement of the two power-plants at Lake Spaulding, which lies below Fordyce, from approximately 6,000 to 15,750 horsepower combined generating capacity, and the carrying capacity of Drum canal was increased from 350 to 500 cubic feet per second.

In the region of the Mother Lode, work proceeded rapidly at Salt Springs dam-site, following the completion of a well-constructed road leading from the Alpine highway to the site by way of Tiger Creek. Rock is now being quarried and placed in the abutments and it is expected that by this fall our engineers will be ready to divert the water for construction purposes and begin work on the foundations of the dam.

In the way of steam-electric generation work was started on a new 37,500 k. w. turbine at Station "C," Oakland.

In addition to these more spectacular features, much has been done in the way of extension and betterment of transmission and service facilities. New substations have been constructed, notably the high-tension substation at San Jose, where electric energy coming in over the 110,000-volt line from Newark is transformed down to 11,000 volts for distribution over the Garden City and a considerable portion of Santa Clara Valley. There has also been much accomplished in reconstruction and reinforcement of transmission lines, both high-tension and local.

On the gas side, there was accomplished a general building up of central manufacturing plants, with new machinery and, in some instances, additional gas generating facilities. Those on the list include the sta-

tions in San Francisco, Oakland, Sacramento, San Jose, San Rafael, Fresno, Vallejo and Stockton.

Our company has pursued its policy of abandoning the smaller plants in favor of service at high pressure from the more central stations. As an instance, Oroville now receives gas from the Marysville works and Chico is next on the list. This, of course, entails the abandonment of the Chico and Oroville plants.

And now, to quote President Hockenbeamer, "we look into the eye of 1928." Our company contemplates the expenditure of \$15,000,000 in new construction work. On the electric side the work at Salt Springs will be proceeded with. At Spaulding the new power-plant on the north rim of the lake, at the outlet of the Nevada Irrigation District's conduit from Bowman reservoir, will be constructed, with an installed capacity of approximately 9,000 horsepower. With the increase in installed capacity of the other two Spaulding plants and the enlargement of Drum canal, a new generating unit of 16,750 horsepower will be installed at Drum power-house.

On the gas side, high-pressure construction work will again be in order. The Chico line to Marysville will be completed. Improvements will be made in the line from San Francisco down the peninsula. The gas-generating plant at Lodi will be abandoned and that community supplied at high pressure from Stockton. In Alameda County a high-pressure line will be constructed from Hayward south as far as Centerville. As in the preceding year, much will be done in the way of new equipment for the stations and the general betterment of service facilities.

Our readers are aware that in the spring of last year our company acquired by purchase the stock of the Sierra and San Francisco Power Company, whose properties for some years it had been operating under lease, and also acquired a controlling interest in the stock of the Western States Gas and Electric Company and the Coast Valleys Gas and Electric Company. Descriptions of these properties were given in a previous issue. The result of these purchases will be to round out, so to speak, the "Pacific Service" territory and give our company additional opportunity to give the best possible service at the least possible cost to the consumer.

In this connection it may be mentioned that the company's administration has per-

fectected a plan for a voluntary reduction of rates, with an estimated saving to our consumers of approximately \$1,800,000. Public announcement has already been made of this. This plan, of course, entails a considerable loss of revenue to the company, but this loss should be in a large measure offset by the new business added as a result of an aggressive sales campaign throughout the entire "Pacific Service" territory.

Another recent development of importance is the increase in the company's authorized stock capitalization from \$160,000,000 to \$400,000,000, which the stockholders adopted at a special meeting held on February 13, 1928. This does not mean, of course, that all of the additional stock authorized will immediately become outstanding. It does mean that the company's rapid growth has necessitated the authorization of a larger nominal capitalization, so that additional stock issues may be sold, from time to time, as the needs of the company's business dictate.

The amended articles of incorporation also provide for two new classes of preferred stock, bearing dividends respectively at the rate of $5\frac{1}{2}$ and 5 per cent annually. The preferred stock already outstanding, and which is held by approximately thirty thousand stockholders, will continue, as in the past, to bear dividends at the rate of 6 per cent.

Great Britain is to reorganize its electric light and power facilities in accordance with American principles of generation and power interconnection. The Board appointed under the recently passed Electricity Act Supply, believes that a complete reorganization should take place before considering a reduction in rates.

In an area covering some 4980 square miles, including almost the entire industrial, coal and shipbuilding activities in Scotland, there are now 42 plants owning 36 generating stations. This number it is proposed to reduce to 10, of which 4 will be super-power steam-driven stations already in existence, 2 will be water-power plants on the Clyde, and 2 new super-power stations will be constructed. It is expected that it will take ten years to complete the program.

Standardization of frequency and current is now being undertaken and the scheme involves the construction of an overhead transmission network operating at 132,000 volts to link up all ten stations.

In Memoriam

With deep regret we have to record the passing of Charles Simpson Northcutt, manager of San Joaquin Division, who died at Stockton December 17th last of injuries received in an automobile accident.

He was a native of Marietta, Georgia, and there he received a common school education. He started his business career in a bank at Atlanta, where he worked for three years and, then, like many young men of ambition and energy, he turned his steps westward. He came to California and entered the employ of the Sierra and San Francisco Power Company as timekeeper. During a period of thirteen years of active service he was conspicuous for his intelligence and industry and attained the position of manager of his company's Stanislaus Division, with headquarters at Modesto. When the properties of the Sierra and San Francisco Company were leased by "Pacific Service" in January, 1920, Northcutt was retained in his position, and when our company's territorial divisions were reorganized in 1921 he was made manager of San Joaquin Division. Last year, when the properties of the Western States Gas and Electric Company were purchased, the head office of the division was moved to Stockton.

He did much constructive work in his short life of forty-one years, and had he been spared he must inevitably have gone higher. How well he was regarded by the management of our company may be gathered from a letter addressed by our company's president to the Oakdale Irrigation District in response to resolutions of sympathy adopted by that organization. Mr. Hockenbeamer wrote:

"Mr. Northcutt was an indefatigable worker, yet in his relations with his associates in this company, as well as with those outside of our organization with whom he came in daily contact, he maintained a never-failing friendliness and courtesy.

"We feel that in his passing the Pacific Gas and Electric Company lost an unusually capable executive, and the State of California a valuable citizen."

All of us in the "Pacific Service" family feel that we have lost a cheerful and loyal companion. We mourn with his widow, and extend to her our sincere sympathy at this time of her great sorrow.

Mr. H. B. Heryford, heretofore manager of West Side Division, is appointed to the managership of San Joaquin Division, taking the place of the late Mr. Charles S. Northcutt.

Mr. Heryford has been connected with the gas and electric industries in California for the past 25 years. He was born in Lincoln, California, and started his public utility career at Colusa, where he entered the employ of the Colusa Gas and Electric Company in March, 1903. Three years later he was made manager of the company, which in 1905 became a part of the California Gas and Electric Corporation, the immediate predecessor of Pacific Gas and Electric Company. In 1909 he was made manager of the Chico district of "Pacific Service," and held that position until 1921, when under the plan of territorial reorganization effected by the late Mr. Creed, our president, he was transferred to Red Bluff as manager of West Side Division.

He became a man of prominence in that territory in a very short while. He was president of the Red Bluff Chamber of Commerce for three years, and for many years has been a director. He is a member of the Rotary Club, and has been active in fraternal organizations, being at the present time Exalted Ruler of his lodge of Elks. In addition, he is a member of the Red Bluff Union High School board, director of the Sacramento Regional Citizens Council and a member of the California Development Association. To his friends he is known as "Jack" Heryford. He may be said to have passed almost his entire life in the Sacramento Valley. Now he goes to the San Joaquin territory. His transfer to Stockton gives him command of one of the largest and most important divisions in the "Pacific Service" system.

Following the transfer of Mr. Heryford to Stockton, it has been decided to abolish the West Side Division. Such portion of the division as lies in Tehama County will become a part of the Shasta Division. Mr. G. R. Milford, as manager of the division, will transfer his headquarters from Redding to Red Bluff.

The portion of West Side Division lying in Glenn County will become a part of the de Sabla Division, under Mr. I. P. Adams as manager. Mr. Adams will retain his headquarters at Chico.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 965,000 CONSUMERS OF
GAS ❖ ELECTRICITY ❖ WATER ❖ STEAM
 2,515,901 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity.....	310	1,750,272	37	164,675	347	1,914,947
Gas.....	84	1,781,375	5	14,702	89	1,796,077
Water (Domestic).....	20	24,100	4	18,500	24	42,600
Railway.....	1	105,000			1	105,000
Steam Heating.....	2	1,003,000			2	1,003,000

Place	Population	Place	Population	Place	Population	Place	Population	Place	Population
Acampo.....	1,000	Coyote.....	250	Hollister.....	4,500	Newark.....	1,100	Saratoga.....	1,300
² Agnew.....	125	Crockett.....	2,500	Honcut.....	500	⁵ Newcastle.....	750	² Sausalito.....	3,800
¹ Alameda.....	35,140	Crows Land- ing.....	300	Hopland.....	500	Newman.....	1,250	Seaside.....	350
² Albany.....	6,000	² Daly City.....	6,500	Hughson.....	625	Niles.....	1,850	² Sebastopol.....	2,000
Alamo.....	100	Danville.....	500	Hydesville.....	200	Nord.....	60	Shavmut.....	100
Alleghany.....	300	Davenport.....	500	Iducness.....	215	Notoma.....	200	Shasta.....	46
Alta.....	100	² Davis.....	1,750	¹ Jonc.....	900	^{2,6} Novato.....	1,000	Sheldon.....	300
Alton.....	100	Dayton.....	60	^{5,8} Irrington.....	1,200	¹ North Sacra- mento.....	2,500	Shellyville.....	200
Alvarado.....	1,120	Decoto.....	700	^{5,8} Jackson.....	2,500	Oakdale.....	2,000	Sheridan.....	50
Alviso.....	640	⁶ Del Monte.....	300	^{5,6} Jamesstown.....	1,000	^{2,9} Oakland.....	295,000	Shingle Springs.....	40
⁵ Amador City.....	750	Denair.....	400	Jenny Lind ..	100	Oakley.....	300	Smartsville.....	300
Anderson.....	1,180	Diamond Springs.....	200	Junction City..	50	Occidental.....	600	Soledad.....	475
Angel Island.....	500	Dixon.....	1,200	Kelseyville.....	600	Olema.....	155	⁶ Soquel.....	875
Antioch.....	2,800	Dobbins.....	100	Kennett.....	492	Orland.....	2,100	Sonoma.....	1,000
Applegate.....	100	Drytown.....	200	² Kentfield.....	1,000	^{2,8} Orono.....	7,000	^{5,6} Sonoma.....	3,500
⁶ Aptos.....	200	Dunbart's Mills.....	250	Kenwood.....	300	² Pacific Grove..	5,000	³ Soulsbyville.....	200
Arbuckle.....	900	Durham.....	600	Keweenaw.....	20	^{6,7} Palo Alto.....	9,550	Francisco.....	6,500
Arcata.....	2,200	⁵ Dutch Flat....	400	² King City.....	1,600	Paradise.....	600	Spreeckels.....	450
Artois.....	100	Eldridge.....	500	Kingston.....	100	Patterson.....	700	Standard.....	800
Asti.....	100	^{2,6} El Cerrito.....	3,000	Knights Ferry	200	² Pebb Beach.....	300	^{2,7} Stanford Uni- versity.....	3,652
² Atherton.....	800	El Dorado.....	60	Knights Land- ing.....	525	² Penn Grove.....	250	Stanislaus.....	160
⁵ Auburn.....	3,000	Elk Grove.....	1,450	La Fayette.....	300	⁵ Penryn.....	250	² Stockton.....	55,000
Bangor.....	50	Elmeria.....	300	¹ La Grange.....	200	Perkins.....	50	⁶ Suisun.....	800
Banta.....	50	El Verano.....	500	Larkspur.....	1,250	² Petaluma.....	7,500	² Susun.....	800
² Barber.....	500	Empire.....	250	Lathrop.....	300	² Piedmont.....	9,000	Sunnyvale.....	2,700
² Belmont.....	1,000	Emeryville.....	5,000	Lewiston.....	100	^{6,7} Pittsburg.....	8,500	Sutter City.....	500
Belvedere.....	750	Escalon.....	700	^{5,8} Lincoln.....	2,000	Pleasantville ..	2,250	⁵ Sutter Creek..	1,000
Benicia.....	2,750	Esparto.....	600	² Live Oak.....	1,000	Pleasanton.....	1,800	Tehama City..	200
² Ben Lomond..	500	Eureka.....	20,000	Livermore.....	3,600	Plymouth.....	400	Thermalito.....	250
² Berkeley.....	80,000	² Fairfax.....	1,200	Lockeford.....	500	Point Reyes....	310	Thornton.....	135
Bethany.....	50	Fairfield.....	1,200	^{2,6} Lodi.....	5,000	Port Costa.....	990	Tiburon.....	500
^{2,6} Biggs.....	750	Fall River.....	500	Loleta.....	800	Potter Valley..	600	Towle.....	50
Big Oak Flat..	150	Ferndale.....	1,500	² Lomita Park..	1,325	Princeton.....	300	Tracy.....	4,500
Blue Lake.....	500	Field's Land- ing.....	200	Loomis.....	500	² Red Bluff.....	3,500	² Tracy Pinos..	400
Bolinas.....	400	Finley.....	100	Los Altos.....	1,800	^{2,6} Redding.....	5,000	^{5,6} Truckee.....	1,500
Boyes Springs.	1,000	Florin.....	1,400	Los Gatos.....	4,750	² Redwood City..	8,000	Turlock.....	5,000
Brentwood.....	500	Folsom City..	1,500	Los Molinos....	450	² Richmond.....	28,700	⁶ Ukiah.....	3,000
Browns Valley	125	Forest City.....	200	Lytton.....	100	Richvale.....	500	Upper Lake....	750
² Burlingame..	13,150	Forestville.....	300	Madison.....	300	Rio Dell.....	600	⁶ Vacaville.....	1,300
Barney.....	200	Fortuna.....	1,200	Magalia.....	100	Rio Nido.....	250	Valley Home...	200
Butte City.....	200	French Camp..	200	Manteca.....	2,000	Rio Vista.....	1,100	Valley Springs	298
Byron.....	400	French Gulch..	170	Manton.....	65	Ripon.....	1,000	^{2,6} Vallejo.....	22,750
Calistoga.....	1,000	Fresno.....	72,000	² Mare Island..	600	Riverbank.....	1,200	Victor.....	200
Campo.....	300	Galt.....	1,000	² Martell.....	100	Rocklin.....	700	Vina.....	300
Campbell.....	1,500	Gerber.....	400	Martinez.....	7,000	^{6,7} Rodeo.....	900	Vineburg.....	250
Camp Meeker ..	300	Geserville.....	750	² Marysville....	8,500	Rohnerville....	300	Walnut Creek..	2,500
Cana.....	500	Gilroy.....	3,700	Maxwell.....	600	^{1,8} Roseville.....	7,000	Warm Springs..	300
Capitola.....	450	Glen Ellen....	1,200	McArthur.....	167	² Ross.....	900	² Washington..	800
Carlella.....	75	Gold Run.....	50	² Menlo Park....	3,500	Sacramento.....	105,000	Waterford.....	400
Carmel.....	2,500	Gonzales.....	500	Meridian.....	250	Salida.....	300	Watsonville...	7,300
Carmel High- lands.....	300	Graton.....	250	Middletown....	580	³ Salinas.....	6,500	Weaverville...	500
Castroville....	400	Grass Valley..	6,000	² Millbrae.....	350	² San Andreas...	600	Wheatland.....	650
Cement.....	1,000	Greenfield....	350	Mills.....	50	² San Anselmo..	4,500	Williams.....	800
Centerville....	1,775	Gridley.....	2,500	² Mill Valley....	3,500	San Ardo.....	300	Willow Glen...	2,600
Ceres.....	1,100	Grimley.....	500	Millville.....	200	² San Bruno.....	2,175	² Willows.....	3,000
² Chico.....	12,000	Groveland.....	250	Milpitas.....	400	² San Carlos.....	1,300	Windsor.....	600
² Chico Vecino.	2,500	Guerneville...	1,200	Mission San Jose.....	500	^{2,8} San Francisco.	708,000	Winters.....	900
Chualar.....	300	Hamilton City	300	Modesto.....	17,000	² San Jose.....	68,000	Woodbridge....	250
Clements.....	200	Hammonton...	500	Mo'ehumne....	237	² San Juan.....	500	Woodland.....	6,950
Cloverdale.....	1,000	Hayward.....	5,000	Monte Rio.....	500	² San Leandro..	12,000	Woodside.....	300
⁵ Colfax.....	800	Hedburg.....	3,000	² Morgan Hill..	1,200	² San Lorenzo..	1,000	Wyandotte.....	250
College City..	250	^{6,7} Hercules.....	600	² Mountain View.....	3,000	² San Lucas.....	300	Yolo.....	400
Collinsville....	300	Hickman.....	40	² Napa.....	7,000	² San Mateo.....	11,500	² Yuba City.....	4,000
² Colma.....	2,900	² Hillsborough.	1,000	Nelson.....	500	² San Pablo.....	1,500	Zamora.....	100
^{5,6} Columbia.....	400	Unmarked—Electricity only.		² Nevada City..	1,800	² San Quintin..	3,500	Total Cities and towns.....	2,031,587
² Colusa.....	2,200	¹ Gas only.				² San Rafael....	7,800	Add Suburban Population.....	454,314
Concord.....	4,200	² Gas and Electricity.				^{2,8} Santa Clara...	6,500	Total Popula- tion Served 2,515,901	
Copperopolis..	300	³ Gas, Electricity and Water.				² Santa Cruz....	17,500		
Corelia.....	250	⁴ Gas, Elect. and St. Railways				² Santa Rita.....	150		
Corning.....	1,800	⁵ Electricity and Water.				² Santa Rosa....	14,000		
² Corte Madera.	1,000	⁶ Electricity supplied through other companies.							
² Cotati.....	600	⁷ Gas supplied through other companies.							
Cottonwood....	704	⁸ Water supplied through other companies.							
		⁹ Steam Heating.							

Unmarked—Electricity only.

¹—Gas only.

²—Gas and Electricity.

³—Gas, Electricity and Water.

⁴—Gas, Elect. and St. Railways

⁵—Electricity and Water.

⁶—Electricity supplied through
other companies.

⁷—Gas supplied through other companies.

⁸—Water supplied through other companies.

⁹—Steam Heating.



BACK OF THE
**BONDS AND
STOCKS**
OF THE
**Pacific Gas and
Electric Company**
ARE

Physical Assets the value of which substantially exceeds the Company's entire capitalization:

A Trained Organization of eleven thousand employees, backed by the accumulated experience of three-quarters of a century of successful operation:

A Progressive Business which never fails to increase year by year, and which furnishes essential services to almost one million customers:

A Field of Operations 59,000 square miles in extent, unusually well endowed with natural resources, and comprising one of the most rapidly developing sections of the entire country.

This Company's securities are owned by upwards of ninety thousand investors. They enjoy a nation-wide market. Ask your banker or broker about them, or write for descriptive circulars to:

Pacific Gas and Electric Company
245 Market Street, San Francisco, Cal.

PACIFIC SERVICE MAGAZINE

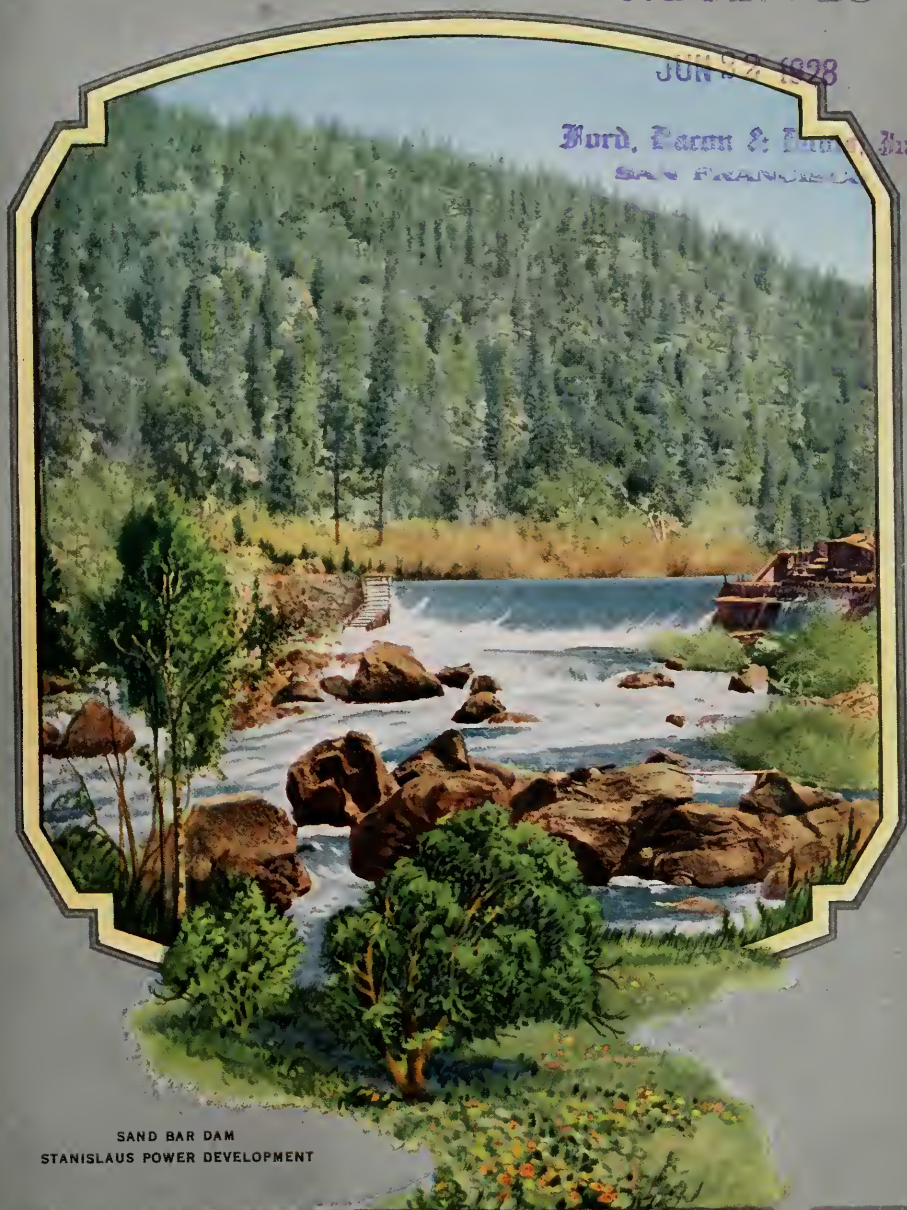
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Ford, Bacon & Evans, Inc.

SAN FRANCISCO



SAND BAR DAM

STANISLAUS POWER DEVELOPMENT

Vol
17

APRIL 1928

No
4

Pacific Service Magazine

Volume XVII

Number 4

Contents for April, 1928



EL DORADO POWER-PLANT, ON AMERICAN RIVER	Frontispiece
THE "PACIFIC SERVICE" RECORD FOR 1927—	
INCREASED REVENUES, DIMINUTION IN PROPORTIONAL OPERATING AND ADMINISTRATIVE COSTS AND THE ACQUISITION OF VALUABLE NEW PROPERTIES THE OUTSTANDING FEATURES	107
OUR NEWLY ACQUIRED PROPERTIES—	
WESTERN STATES AND COAST VALLEYS	110
PHILBROOK DAM AND RESERVOIR IN THE DE SABLA TERRITORY	120
SWEEPING REDUCTION IN RATES TO BENEFIT ELECTRICAL CONSUMERS	122
IMPROVEMENTS IN GAS SERVICE RESULT OF CONSTANT EXPERIMENT	126
HOUSEKEEPING ON COMPANY'S PROPERTIES— REWARDS FOR ORDERLY CARE AND ATTENTION	128
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	132
EDITORIAL	134



□ Donald power plant on the American river above Placerville. Rating, 33,512 horsepower.
Head, 1908 feet.

PACIFIC SERVICE MAGAZINE

Volume XVII

APRIL, 1928

Number 4

The "Pacific Service" Record for 1927

Increased revenues, diminution in proportional operating and administrative costs and the acquisition of valuable new properties the leading features.

A substantial increase in gross operating revenues, with a considerably smaller proportional increase in the aggregate of operating, administrative and other expenses, and the acquisition by purchase of three important public utilities operating immediately adjacent to and, in some instances, within the "Pacific Service" territory, were the leading features of the "Pacific Service" record for 1927 as presented to our company's stockholders at the annual meeting held in San Francisco, April 10th.

Our company's gross operating revenues in 1927, covering, as in preceding years, the operations of the Pacific Gas and Electric Company and its wholly owned subsidiaries, amounted to \$54,719,227, an increase of \$3,758,656 over the preceding year. Thus for the twenty-second year in succession aggregate gross operating revenues reached a new peak. Early in the year the company disposed of its public telephone system, and several of its water-distributing systems, including those at Stockton, Redding, Willows, Livermore, Dixon and Oroville, otherwise this total would have been exceeded by more than \$400,000. The consolidated income account, however, increases the above total by a sum of \$540,713, representing miscellaneous income, and an amount of \$361,104 representing the surplus of affiliated companies accruing to "Pacific Service" during the last eight months of 1927 from its investment in the stocks of the Western States and Coast Valleys Gas and Electric Companies. Adding these items to the net operating revenues, the total net income available during 1927 for the payment of fixed charges, depreciation and dividends was \$25,445,591, or \$3,974,076 more than in the preceding year and the largest since the company's organization.

To the record total of operating revenues for the past year the electric department contributed \$33,851,104, or 61.87 per cent of the whole, with an increase of \$2,472,646 over the previous year. The gas department was responsible for a total of \$19,271,711, or 35.22 per cent of the total, with an increase of \$1,744,330 over 1926. The number of consumers receiving electric service from our company as of December 31, 1927, stands at 506,987. This aggregate includes consumers gained by the acquisition of the Western States and Coast Valleys Gas and Electric Companies and shows a total increase of 72,100 electric consumers over the previous year. The number of consumers for gas service stands at 453,132, an increase of 34,591 over the previous year. It is worthy of note that in the past twenty years our company has made a net gain in electric consumers of 452,215, and of 330,828 in gas consumers. In connection with this record on the electric side, the increase in kilowatt hour sales for 1927, exclusive of acquired properties, exceeded 65,000,000, large gains being made, for instance, in sales for street lighting purposes which, measured in kilowatt hours, showed an increase of 12.84 per cent over 1926; sales for commercial and residential lighting, which increased 11.51 per cent; and sales for commercial and residential heating and cooking, which increased 37.54 per cent.

On the gas side the increase in cubic feet sales amounted to 1,800,240,000, an increase of 11.05 per cent over 1926. The per capita consumption of gas continues to advance, the annual consumption per consumer standing at 45,590 cubic feet, as against 43,310 cubic feet in 1926. It is worthy of note, too, that in the last ten years the total sales of gas on all of our company's properties have increased 136.8 per cent, compared with an increase of 86.3 per cent in the aggregate number of consumers served.

In the direction of extensions and betterments of service to the consumer much was accomplished during 1927. In June last the Melones power plant, of 36,193 horsepower capacity, on the Stanislaus river below Melones dam, was placed in operation, our company thereby fulfilling its part of a co-operative agreement with the Oakdale and South San Joaquin Irrigation Districts, owners and operators of the water storage development. This accomplishment has been commented upon most favorably in its establishment of friendly relations between enterprises having a common interest in the progress and development of the State. In the Sierra Nevada territory our company's customers for electric energy and, also, water for irrigating purposes were benefited by the work of raising the dam at Lake Fordyce, the parent reservoir of our company's Spaulding-Drum system. The capacity of the reservoir was increased from 20,000 to 46,662 acre-feet, making Fordyce the second largest reservoir in the "Pacific Service" system. Increased equipment in the two power plants at Lake Spaulding which lie below Fordyce, enlargement of Drum canal and the installation of an additional generator in Drum power house are part of the same enterprise. In the Mother Lode region the work of building roads into Salt Springs dam site, on the Mokelumne river fifty miles above Electra, and the clearing of the site were among the accomplishments, and the work of placing rock in the abutments was started. The diversion dam at Pit Four development was completed in the early summer of 1927. This dam creates a reservoir of 1,330 acre-feet and permits the flow of Pit river to be so regulated as to make possible an increase in the peak capacity of Pit Three of approximately 37,500 horsepower.

The task of extending and improving transmission and service facilities is a never-ending one. During the past year new substations were constructed, notably the high-tension substation at San Jose, where electric energy coming in over the 110,000-volt line from Newark is transformed down to 11,000 volts for distribution over the Santa Clara valley; and many existing substations were improved and enlarged.

In the way of steam-electric generation, work was started on a new 37,500-kilowatt turbine to be installed at Station "C," Oakland.

On the gas side there was a general building up of central manufacturing plants, with additional gas-generating facilities. Our company's policy of abandoning smaller plants in favor of service at high-pressure from the more central stations was pursued and, as an instance, Oroville now receives gas from the works at Marysville and the work of extending the high-pressure system to Chico is under way. Similar accomplishments during 1927 included high pressure gas mains from Stockton to Lodi, a distance of 11½ miles, and from Sacramento to Roseville, a distance of 14.3 miles.

But the outstanding feature of our company's operations last year, undoubtedly, was the acquisition of a controlling stock interest in the Western States Gas and Electric Company and the Coast Valleys Gas and Electric Company, together with the entire capital stock of the Sierra and San Francisco Power Company. The addition of the two former companies added to the "Pacific Service" system a generating capacity of 44,337 horsepower in hydro-electric plants, 15,918 horsepower in steam-electric plants and gas plants with an aggregate daily capacity of 7,136,000 cubic feet. These figures are exclusive of the properties of the Sierra Company, which has been operated by our company under the terms of a fifteen year lease since January 1, 1920.

Authority to merge the properties of these companies in the "Pacific Service" system has been granted by the State Railroad Commission. An article descriptive of the newly acquired properties will be found elsewhere in this issue.

Including the properties mentioned, at the close of 1927 our company had 32 hydro-electric plants in operation, with a total installed capacity of 621,213 horsepower. The company's resources in the way of steam electric generation included 9 plants, with a total installed capacity of 206,266 horsepower. In all, then, the company's aggregate electric-generating resources at the close of 1927 were 827,479 horsepower. The total load connected to the company's system aggregated 1,954,817 horsepower, an increase during the year of 312,939 horsepower, of which 179,521 horsepower represented the connected load of the Western States and Coast Valley Companies, and 133,418 horsepower the addi-

tional load on existing lines. Electric service was furnished to 310 cities and towns in northern and central California, the total population of the territory served exceeding 2,500,000. On the gas side, our company's manufacturing resources at the close of 1927 embraced 19 plants, with a total generating capacity of 119,096,000 cubic feet per day. In this list are included the newly acquired plants at Stockton and Eureka, of the Western States system, and those at Monterey and Salinas, of the Coast Valleys system. The maximum daily send-out was from San Francisco, on December 24th last, 36,442,000 cubic feet. In second place came Oakland, on the same day, with a send-out of 28,080,000 cubic feet.

At the close of the year there were 9,546 employees on the company's payroll. The total amount expended for wages and salaries during the year was \$16,967,448. Pensions paid to superannuated pensioners aggregated \$65,042. As of December 31st last there were 83 pensioners on the "Pacific Service" roll of honor.

The Pacific Service Employees' Association, a voluntary organization, numbered 7,258 members at the close of the year. The Employees' Disability Plan, instituted some years ago, has a present membership of 4,811, and the amount paid out in benefits last year aggregated \$42,627.

In the twenty-two years since its organization the company has created practically two-thirds of its plant account through its own construction at a cost of \$192,708,701. In addition, other properties have been purchased at a cost of \$34,946,360. The program for the present year as presented to the stockholders at the annual meeting calls for a construction and maintenance budget involving expenditures around \$22,500,000. In the schedule on the electric side, the important items include the Mokelumne river and Spaulding-Drum developments, before referred to, the steam-electric plant at Oakland, new substation construction and enlargement of existing ones, additions to transmission and distribution lines and increased service facilities throughout the "Pacific Service" territory. On the gas side there will be further extensions of high-pressure systems, with reconstruction work and additional equipment for various existing gas-generating plants.

Early in the present year two matters of unusual importance were presented by our company's administration. First, it was decided to increase the company's authorized stock capitalization from \$160,000,000 to \$400,000,000. This does not mean that all of the additional stock authorized will immediately become outstanding; it does mean that the company's rapid growth necessitates the authorization of a larger nominal capitalization so that additional stock issues may be sold, from time to time, as the needs of the company's business dictate. Amended articles of incorporation provide for two new classes of preferred stock, bearing dividends, respectively, at the rate of $5\frac{1}{2}$ per cent and 5 per cent annually; meanwhile the preferred stock already outstanding will continue, as in the past, to bear dividends at the rate of 6 per cent. These measures were formally authorized by the stockholders at a special meeting held February 13th.

Second, it was decided to make a reduction in rates for electricity in every section of the "Pacific Service" territory. Rate schedules were prepared in two forms, one dealing with lighting rates and the other a combination rate covering heating, cooking and other domestic activities. The State Railroad Commission approving, these rates went into effect, the lighting rate on March 1st and the combination rate April 1st.

It is estimated that the annual saving to consumers by the reduced rates will approximate \$1,750,000. This represents the largest voluntary reduction ever made by a utility corporation in the West, covering, as it does, more territory and involving a larger amount than any other previous similar cut in utility rates. It is proposed to offset as far as possible the loss of income resulting from this reduction by an active sales campaign encouraging a greater and more diversified use of electricity, particularly in the home.

President A. F. Hockenbeamer presided at the annual meeting, which was well attended. Complete reports of progress were presented by the President and Mr. F. A. Leach, Jr., First Vice-President and General Manager. At the conclusion of the meeting a resolution was adopted confirming the actions of the administration during the past year. The existing board of directors was re-elected.

Our Newly Acquired Properties--- Western States and Coast Valleys

The most important addition to the company's operating system during recent years was accomplished through the acquisition, by purchase from the Byllesby interests of Chicago, of the Sierra and San Francisco Power Company, the Western States Gas and Electric Company and the Coast Valleys Gas and Electric Company.

The Sierra and San Francisco Power Company operates in eleven California counties, including the city and county of San Francisco, where power is supplied to the Market Street Railway Company under an exclusive contract running until 1953. From the operating standpoint the acquisition of this company is no new thing, for its properties have been operated by "Pacific Service" under lease since January 1, 1920. A general description of the Sierra system appeared in the September, 1920, issue of *PACIFIC SERVICE MAGAZINE*. Since that time important additions have been made, notably in the Melones and Spring Gap power plants on the Stanislaus river: articles describing these were given to our readers during the past year.

We assume, however, that our readers are probably not so familiar with the West-

ern States and Coast Valleys companies, so that a general description of the character and scope of their operating systems may not be amiss at this time.

The Western States Gas and Electric Company was incorporated under the laws of California, November 30, 1910, by H. M. Byllesby and Company, of Chicago, to acquire and operate three separate power systems in California. The first of these systems centered in and around Stockton and was formed by the union of the properties of the American River Electric Company with those of the Stockton Gas and Electric Corporation. The second supplied the territory around Eureka on Humboldt bay and consisted of the properties formerly owned by the Humboldt Gas and Electric Company. The third embraced the properties of the Richmond Light and Power Corporation, which operated a local distribution system in and around the town of Richmond on the east shore of San Francisco bay north of Oakland, power for this system being purchased from the Pacific Gas and Electric Company.

The American River Electric Company dated from 1903. It operated a small water

power plant on the south fork of the American river a short distance northeast of Placerville, with two transmission lines terminating at the city of Stockton, one following the northern route by way of Folsom and Florin and the other the southern route through Jackson, Valley Springs and Harmony Grove. The original American river plant was



American river plant, near Placerville

built in the late '80's, supplied with water from Rock Creek, and transmitted power a short distance to a stamp mill. The generator was a direct-current brush machine, belt-driven by an impulse wheel. On July 1, 1903, work was started upon a new plant which was completed in December of the same year. Water was obtained from the south fork of the American river by means of a diversion dam, conveyed to the power plant by flume and ditch $7\frac{1}{2}$ miles in length and with a capacity of about 110 second feet.

For purposes of service in and around Stockton the company established a steam plant in that city in 1907, equipped with a 1500 k.w. generator. This plant supplied a large part of the power used by the Stockton Gas and Electric Corporation. It is still in operation and is rated at 2,011 horsepower.

The Stockton Gas and Electric Corporation was incorporated July 30, 1907, as successor of the Stockton Gas and Electric Company, which dated from November 24, 1894, and was in turn successor of the Stockton Gas Light and Heating Company, incorporated April 20, 1888. These earlier companies had for many years supplied the city of Stockton and its immediate vicinity with gas and electricity. Until the completion of the lines of the Standard Electric Company of California, with its generating plant at Electra on the Mokelumne river, the entire supply of electricity was gener-



Section of American river flume.

ated at steam stations in Stockton. After the completion of the Electra plant the Stockton company purchased a large part of its power from this system. The first Electra plant was constructed by the Blue Lakes Water Company in 1897. It started operating during that year. The line from that point to Stockton was put into operation about 1899, at about the time the Standard Electric Company took over the Blue Lakes Water Company. This plant burned down and the second, the present one, was constructed in 1902. In 1904 the standard system was purchased by the California Gas and Electric Corporation, the immediate predecessor of the Pacific Gas and Electric Company.

In the way of gas service, the city of Stockton was supplied from a generating plant which dated from early days, the first gas franchise being voted by the city council in 1859, with gas delivered at \$10 per 1,000 cubic feet. The largest daily output at the start was 4,500 cubic feet. Today the reconstructed gas plant at Stockton has a total daily generating capacity of 4,583,200 cubic feet.

Since the Western States Gas and Electric Company acquired the properties of these two corporations a considerable amount of reconstruction work has been completed. In 1915 the equipment of the American



Echo lake, near Sierra summit on the American river side. Western States Gas and Electric system.

river plant was increased, and today its generating capacity is rated at 8,184 horsepower. A short distance above the forebay is the Finnon reservoir, of 600 acre-feet capacity, used for emergency and peaking purposes. The reservoir is supplied with water from two ditches 26 miles in length. Concerning the power plant it is interesting to note that the same wood-stave penstocks are in use as were installed in 1903.

In 1922 construction was started upon the El Dorado, an up-to-date hydro plant of considerable capacity on the south fork of the American river some thirteen miles upstream from the American river plant. Water was taken from the river by means of a crib diversion dam twenty-two miles upstream from the power house site and from the intake at that point the El Dorado canal was constructed, 21,000 feet of its length lined with concrete, 75,000 feet of earth section lined with wood panel or riprap, and 19,000 feet of wood flume. There are 26 concrete spillways, 21 wood spillways and 2 large inverted siphons on this



Medley lakes, Western States Gas and Electric system. Mosquito Pass in background at the right.

canal, which is of 150 cubic feet per second capacity. At the lower end of the canal is located the forebay with a capacity of 400 acre-feet. From this water is carried by a redwood-stave pipe line consisting of 9,000 feet of 60-inch pipe and 2,000 feet of 54-inch pipe. A steel surge tank over 200 feet high marks the end of the wood-stave pipe line and the beginning of the steel pipe line which extends some 3,000 feet down the canyon-wall to the plant on the river.

The head or drop from the top of the hill to the power house is 1908 feet, the highest head on the "Pacific Service" system. The power house building is a first-class concrete and steel structure, with a temporary wall at the upstream end for future extension.

It is adjoined by an outdoor, steel, high-tension bus and switching structure. The generating equipment consists of two units and the plant's total generating capacity is rated at 33,512 horsepower. It is understood, however, that this plant is capable of much higher development when there is need for it.

A series of natural reservoirs lies an average distance of twenty miles above the El Dorado



Twin lakes reservoir, Western States system.

canal. These include Medley lakes, of 5,000 acre-feet capacity; Echo lake, 2,000; Silver lake, 5,000; and Twin lakes, 20,000. Excellent reservoir sites are located on Silver Fork, Alder creek and Plum creek, all of which may be required when the El Dorado development comes to be enlarged.

The Eureka system was acquired from the Humboldt Gas and Electric Company, which was incorporated February 26, 1907, as a consolidation of the North Mountain Power Company and the Eureka Lighting Company. The only hydro-electric plant on this system was constructed on Trinity river, near Junction City, but received its water supply from Canyon creek. The transmission line from the plant to Eureka is about 65 miles long. Hydro-electric power was first delivered in Eureka from the Junction City plant in June, 1905, prior to which time the city had been supplied with electricity by the Eureka Lighting Company, incorporated November 15, 1894.



Scene on El Dorado canal. Concrete-lined section. Western States system.

The Junction City plant today is rated at 2,641 horsepower. The Eureka steam station, which is still in operation, has a rating of 12,064 horsepower.

The Richmond system was acquired by the Western States company from the Richmond Light and Power Corporation. At one time it operated its own steam electric plant, but this was shut down upon the signing of a long-term power contract with "Pacific Service."

At the present time the Western States system serves electric consumers in eight counties of California. It controls electric service in the city of Stockton and from that point northward as far as Sacramento. This territory, as well as portions of El Dorado, Calaveras and Amador counties, is served from the two American river hydro-electric plants.

In the way of gas service, the Western States system, in addition to the Stockton plant, operates a gas-generating plant at Eureka of 400,000 cubic feet daily capacity.

Coast Valleys Gas and Electric Company is the outgrowth of the development and consolidation of a number of small utilities formed to serve individually the towns of the Salinas valley and the Monterey peninsula.

The first of these small plants was located in the city of Salinas,



El Dorado wood-stave pipe line.

the county seat of Monterey county, and the operating company was incorporated on May 4, 1875, for the purpose of delivering gas and water to the city of Salinas under the name of the Salinas City Gas and Water Company. The first gas was made from coal and in 1877 a wooden tower and two 50,000-gallon redwood-stave tanks were erected to furnish the required water storage for domestic service. Later these tanks were raised to an elevation of 80 feet and were only replaced with a 200,000-gallon steel tank and tower 100 feet high in 1924, after a life of 47 years of useful service.

This same company extended its activities into the field of electric service in October, 1888. The Salinas property was reorganized in 1896 under the name of the Salinas City Light and Water Company and again in 1902 under the name of the Salinas Water, Light and Power Company.

In the meantime the Monterey Electric Light and Development Company had been incorporated on the Monterey peninsula to serve that portion of Monterey county. The first electric franchise was granted by the city of Monterey to one E. M. Carver on December 30, 1890. Some of the rates specified in this franchise are interesting. For instance, the rate for arc lights burning from sunset to 9 P. M. was \$3 per week. If burned until midnight the rate was \$4 per week. Service from sunset to 10 P. M. for incandescent lamps varied from \$1.50 per month for a 16 candlepower lamp to \$6 per



Wood-stave penstock and surge-tank.
El Dorado power development.

month for 150 candlepower.

The first franchise in Pacific Grove was granted to the Monterey Electric Light and Development Company on February 19, 1891.

A new corporation known as the Monterey Gas and Electric Company acquired these properties on September 1, 1902, and purchased the Salinas properties on October 10th of the following year, and shortly after, during the latter part of 1903, the combined properties were reorganized under the name of the Monterey County Gas and Electric Company.

Prior to 1911 electricity was generated in Monterey in a steam electric plant, which was laid out by Mr. F. G. Baum and installed by C. C. Moore & Co. This plant consisted of two 500 kw. General Electric vertical turbines. The Salinas electric plant consisted of two 150-horsepower Corliss engines belted to two 125 kw. generators. Both of these plants are still kept in repair and can be run for standby service in cases of emergency.

In 1911 a 20,000-volt transmission line was constructed to interconnect the Monterey and Salinas plants and in November of that year the water properties in Salinas were separated from the gas and electric properties and were oper-



Interior of El Dorado power house

ated thereafter under the name of the Salinas Valley Water Company. At the same time the other holdings of the Monterey County Gas and Electric Company were transferred to the California Consolidated Light and Power Company, a corporation formed by Mr. F. G. Baum and his associates on July 7, 1911, for that purpose.

In March, 1912, Coast Valleys Gas and Electric Company was incorporated and took over the properties of both the Salinas Valley Water Company and the California Consolidated Light and Power Company.

In the meantime a group of local men in King City had formed a company known as the King City Water, Light and Power Company in October, 1908. This company drilled a central well for a water supply for the town and installed a 75 h.p. reciprocating engine belted to an electric generator. These King City properties were purchased by the Coast Valleys Gas and Electric Company in May, 1912.

Coast Valleys Gas and Electric Company was organized by the same people who were interested in the California Railway and Power Company, a Delaware corporation, whose principal subsidiaries were the United Railroads of San Francisco and the



Western States Company's headquarters in Stockton.

Sierra and San Francisco Power Company. The Coast Valleys Gas and Electric Company was controlled and operated by the California Railway and Power Company, as a subsidiary of the latter, until the year 1921, when the controlling interest was purchased by Mr. M. B. Starring, who was at that time president of the California Railway and Power Company.

On November 10, 1923, control of the properties passed by purchase to the Standard Gas and Electric Company and from that time until June 1, 1927, when purchased by Pacific Gas and Electric Company, were managed and operated by Byllesby Engineering and Management Corporation.

Immediately upon the formation of the Coast Valleys Gas and Electric Company a contract was made with the Sierra and San Francisco Power Company, whereby the latter agreed to construct a 60 k. v. transmission line from Port Marion substation, at the south end of San Fran-



General view of Western States service stations in Stockton.
Electric station "A" in foreground.



Monterey gas plant and electric substation. Coast Valleys system.

cisco bay, to Salinas and to supply all the electricity required by Coast Valleys Company for twenty-five years commencing January 1, 1913.

About the same time Coast Valleys Company commenced the construction of a 30 k.v. line from Salinas to King City. About 1917 the voltage on this line was raised to 60 k.v. as far south as Soledad and about 1922 the 60 k.v. was carried all the way through to King City, and about the same time an 11 k.v. line was run from King City south, a distance of twenty-two miles, to San Ardo, thereby completing service

over the entire length of the tillable portion of the valley of the Salinas river.

Prior to 1920 the entire territory was dependent on 76 miles of single-circuit wood-pole line from Port Marion to Salinas and 47 miles more of single-circuit line to King City. Fog conditions along many sections of the route of this line were bad and total interruptions of two or three hours were not uncommon.

In 1920 a second circuit was constructed through to Soledad and in the spring of 1927 this second line was continued all the way through to King City. In the spring



Salinas substation, main distributing substation for Coast Valleys division of "Pacific Service."

of 1924 a second 22 k.v. line was built from Salinas to Monterey. A 30 k.v. line extending 45 miles into the San Benito mountains from Soledad was built in 1919 to carry electric service to one of the oldest and largest quicksilver mines in the United States at New Idria.

A large percentage of the electric load of Coast Valleys Gas and Electric Company is the pumping of water for irrigation. Substations, stepping the voltage down from 60 k.v. to 4 k.v. for distribution, are located at intervals of approximately 10 miles along the 60 k.v. line through the valley. The earlier of these stations were constructed of corrugated iron on wood frame, in conformity with general practice of the day in which they were built, but those which have been built since 1924 are of hollow tile construction with stucco finish and tile roof in very attractive mission style of architecture. There are now six of these located at Monterey, Carmel, Moro Cojo, Chualar, Gonzales and Greenfield.

In 1925 and 1926 Pacific Gas and Electric Company, as the lessee of the Sierra and San Francisco Power Company, constructed a 100,000-volt transmission line from Manteca to Salinas, via Newman and crossing the Mt. Diablo range through the Pacheco pass. At the same time the Pacific Gas and Electric Company and Coast Valleys Gas and Electric Company constructed a joint substation at Salinas, in which the former company installed a 10,000 k.v.a. synchronous condenser to control and regulate the transmission voltage. Modern switching equipment was installed to control incoming and outgoing transmission and distribution lines.

From 1911 to 1922 Monterey depended



200,000-gallon storage tank and pumping station supplying the city of Salinas—Coast Valleys.

for gas service on two straight shot machines of 10,000 cubic feet per hour capacity. In 1922 a complete new gas plant was installed, using a 9 foot 6 inch, two-shell, Jones type of generator of a capacity of 30,000 cubic feet per hour, and this was supplemented in 1925 by the construction of a second unit of the same type and capacity.

In Salinas a complete new gas plant was built and put in operation early in 1926, using a 9-foot straight shot set with a capacity of 30,000 cubic feet per hour, and space in the building provided for a second unit of the same size. At the same time storage was provided in Salinas for 200,000 cubic feet of gas. Up to that time a 30,000 cubic



Warehouse and meter shop adjoining Salinas substation.

feet holder was all the storage capacity available at this plant.

In 1920 gas storage at Monterey was increased from 46,000 cubic feet to 146,000 cubic feet, and in 1927 another 500,000 cubic feet holder was added, the first improvement of major size undertaken under the new management of Pacific Gas and Electric Company.

The territory served by Coast Valleys Company is largely agricultural although the Monterey peninsula, with its attractive summer resorts and its fish-canning industry offers a very considerable residential and industrial load. There are approximately \$5,000,000 worth of sardines packed and shipped from the Monterey canneries each year and, as a by-product of this industry, large quantities of fish meal and fish oil.

At Spreckels, about three miles from Salinas, is located a beet sugar factory with a capacity of 5,000 tons of beets per day, which is said to be one of the largest in the United States.

The principal products of the Salinas valley are fresh milk, condensed milk, cheese, alfalfa, sugar beets, lettuce, artichokes, beans and some fruit. The uplands produce barley and the surrounding hills are devoted to the raising of beef cattle. The valley is approximately 100 miles long and averages about 10 miles in width. It is very fertile and with one exception is irrigated entirely by



Moro Cojo substation, Coast Valleys system.

electrically pumped water. There is a small gravity irrigation system which partially supplies the lands around the little town of Greenfield.

Recent experiments of the Inter-Continental Rubber Company extending over the period of the last six years seem to prove that this section is well adapted to the production of rubber from the guayule shrub, a Mexican plant, and there are some 2600 acres of this shrub now under commercial cultivation as a start for the rubber industry in the valley.

The growth of this territory is rather accurately indicated by the growth in business of the Coast Valleys Company since the first year of its activities as such, commencing in 1913, since which time the continuous records are available. The following table indicates the extent of this growth:

NUMBER OF CUSTOMERS.....	1913	1918	1923	1927
Electric	3,113	4,380	6,834	11,498
Gas	1,645	2,446	3,382	4,980
Water	1,089	1,337	1,642	2,115
GROSS REVENUES				
Electric	\$157,263	\$243,415	\$611,681	\$1,120,803
Gas	42,104	71,462	139,387	269,388
Water	21,315	24,767	34,772	49,720
PAYROLL.....	\$ 57,326	\$ 66,043	\$188,951	\$ 345,892
KW. H. OF ELECTRIC ENERGY SOLD.....	4,230,949	9,489,609	20,422,401	42,091,486
M. CUBIC FEET OF GAS SOLD.....	30,100	43,922	80,960	161,144

The company still operates the city water supply systems in the cities of Salinas and King City.

It will be noted from the above table that the quantity of electric energy sold in 1927 was almost exactly ten times the quantity sold in 1913. What the future holds forth is always a mystery. There is every reason to believe that the same steady rate of growth experienced during the past fifteen years will continue for many years to come. One large banking institution made a survey of business conditions in Monterey county and made the statement, based on this survey, that the territory is still 90 per cent undeveloped.

There is a world of room for future growth of playground territory on the Monterey peninsula. The residential load can double and redouble several times before the saturation point is approached. Large acreages in the Salinas valley will be cut up and intensive cultivation will replace wholesale farming operations. The territory is now pretty well covered with trunk lines and the additional loads will largely be taken care of by short distribution line extensions and gradual increases of substation capacities and distribution feeder copper sizes.

Pacific Gas and Electric Company has already announced the projected construction of another 100,000-volt line from Newark to Salinas, which, with present transmission



Gonzales substation. Coast Valleys system.

facilities, will insure an ample supply of power to this territory for some time to come.

At the time of our acquisition of the properties of the Western States and Coast Valleys Companies, the late Mr. W. E. Creed, our company's president, described the purchase as "both a logical and constructive move in the future development of the electric power service of northern and central California."

The acquired properties for purposes of operation have already been co-ordinated with our company's system, and substantial economies in operation and administration have been effected as a result of this direct and unified management. Early in April of this year the State Railroad Commission officially authorized the physical merger of these properties in the "Pacific Service" system.



Philbrook Dam and Reservoir in the De Sabla Territory

In addition to its purchase of new properties and its prosecution of major development projects in various sections of the "Pacific Service" territory, our company has done considerable work of late in the way of reconstruction and the addition of new facilities to increase the output of some of its older hydro-electric power installations. An interesting item on the list of new facilities is the Philbrook reservoir, in de Sabla section of the "Pacific Service" territory. This is of particular interest from the fact that the de Sabla system, comprising as it does the de Sabla and Centerville power plants on Butte creek, is one of the oldest of the "Pacific Service" chain. The Centerville power plant, together with a 16-mile transmission line to Chico and a 32-mile line to Oroville, was completed in 1900 after about twelve years of more or less leisure work on the part of the Butte County Electric Power and Lighting Company. The entire investment is reported to have been \$175,000. Later the line to Chico was continued down the Sacramento valley to Colusa, a distance of 40 miles, and an independent line was run from the power house to a junction with the Chico-Colusa line. At that time the Centerville power house was delivering 400 k.w. to Chico, 150 k.w. to Gridley, 100 k.w. to Colusa and about 400 k.w. to gold dredges on the Feather river, the total being less than that which today is being delivered to any one of many individual consumers.



Philbrook dam under construction. Note unusual type of earth-moving machine in right background. In the foreground is a Fordson tractor, with sheep-foot tampers attached.

In 1903, another power development organization entered the Butte creek territory, the Bay Counties Power Company, a consolidation of the Nevada County and Yuba Electric Power Companies and whose hydro-electric systems included the recently constructed Colgate plant on the middle fork of the Yuba. A subsidiary company, Valley Counties Power Company, was formed and arrangements made for the purchase by it of the water system of the Cherokee Mining Company, and the properties of the Butte County Power Company. The Cherokee system consisted principally of the head dam in Butte creek and the old Cherokee canal, the upper portion of which is now known as Butte canal. In 1903 the de Sabla power plant was constructed and the water from Butte creek, after flowing through the upper portion of the Cherokee canal, was diverted and dropped 1531 feet to the de Sabla power house and again diverted into the Centerville canal for use through a 577-foot head to Centerville power house. Subsequently the Hendricks canal, about 20

miles in length, was constructed to bring water from the west branch of the Feather river to these power houses. Other improvements to the system were made from time to time. Today de Sabla power plant is rated at 17,426 horsepower generating capacity, and Centerville at 8,579.



Finished crest of dam, showing rubble-facing on the upstream side.

In 1907 the Bay Counties Power Company became the property of the California Gas and Electric Corporation, which later passed to the control and ownership of Pacific Gas and Electric Company. In 1917 "Pacific Service" purchased the properties of the Oro Electric Company and among the properties was the Philbrook reservoir site. This is located on Philbrook creek, a tributary of the west branch of the north fork of Feather river in the northeast corner of Butte county, at an elevation of about 5,400 feet. Construction of a dam at this location was first undertaken in 1908 by predecessors of the Oro Electric Corporation. A heavy storm during the winter of 1908 partially destroyed the incomplete structure, and work on the project was abandoned.

The drainage area which furnishes the water supply for the de Sabla and Centerville plants is largely of lava formation and furnishes a well-regulated runoff. Large storage reservoirs, therefore, are unnecessary for the regulation of stream flows. This condition, while not as perfect as it is in the Pit river area, is not to be found in the region around and about the Sierra Nevada summit, where granite takes the place of lava. There has, however, occurred in the past years a deficiency of water during the low flow season. The only storage on the system prior to the construction of the Philbrook dam was afforded by the Round Valley reservoir, having a capacity of about 1285 acre-feet of water. Of late years a constantly growing population and consequent development of the natural resources of the region have brought about an in-

creased demand for service, and in order to provide a more constant water supply throughout the year our company's engineers, in 1926, undertook the completion of the project.

Actual work was started June 21st of that year. An ancient glacial moraine which had resulted in two shoulders reaching nearly across the valley from both sides, left only a relatively narrow gap that must be filled in order to create storage in the basin above it. Beneath the surface soil in this gap a comparatively impervious layer of clay was found which served as a water seal to prevent the penetration of water under the dam. The dam is an earth-rolled structure about 90 feet high and 850 feet long, with suitable upstream and downstream slopes. The total yardage of material placed in this structure and in a small secondary dam was 169,000 cubic yards. The project was completed by the first of November, 1926. This remarkable progress was accomplished through the use of an unusual amount and variety of earth-moving equipment, the total value of which amounted to over \$150,000. The work was performed by the Kaiser Paving Company, contractors.

Philbrook reservoir is of 5040 acre-feet capacity. This water will normally be used during the fall months when it is most valuable and will increase the annual output of the de Sabla and Centerville plants by approximately 6,250,000 kilowatt-hours.

Subsequent to its use by the company for power generation, the water enters Butte creek and becomes available for irrigation of ranches east of Chico.

Sweeping Reductions in Rates To Benefit Electric Consumers

The recent reductions in electric rates made by our company with the approval of the State Railroad Commission have attracted general attention. However, it is doubtful if our consumers and the public generally fully appreciate the significance of the changes made and the opportunity offered consumers in every section of the "Pacific Service" territory to make a more extensive use of electricity in the home at a very low additional cost.

Our decision to take this important step was not suddenly arrived at, nor was it the outcome of any recent development in our business. It was the natural result of a consistent program which our company has been following for years, having as its objective the placing of our affairs in condition to permit the making of such reductions and changes in rates for electric lighting and domestic service as would stimulate sales and would be in line with good policy. To this end we have constructed a number of large modern hydro-electric plants, and by the acquisition of rights and developments of other companies we have assured ourselves of an ample supply of power at a reasonable cost with which to meet the requirements of our consumers for many years in the future. We have acquired such properties of other companies in the territory that we serve as could be economically operated by our organization. We have been working constantly to improve our credit position in order to secure the advantage of low rates for money and, last but not least, we have been constantly analyzing our operating methods and working for the reduction in costs and improvement in the efficiency of our organization and, at the same time, increasing the quantity and reliability of the service that we render.

In searching for a means of increasing our sales at a rate which would yield something in addition to the marginal cost of producing the additional energy, we decided that our existing lighting and domestic consumers were not using as much electrical energy as they could use with profit to themselves and to us. We felt, therefore, that if we

could increase the consumption of our existing lighting consumers at a rate somewhat consistent with the average rate we now receive, or even somewhat less, such a result would be a benefit to all concerned. This would make available to these customers electrical energy for necessary uses and, as a matter of convenience, at a price which they could well afford to pay, while, at the same time, we would be able to maintain our earnings on a reasonable basis.

With these thoughts in mind, we have redesigned and changed our rate schedules to a form which will, we believe, stimulate and encourage very much greater uses of electrical energy in the home and thus serve to give to our customers the benefits and advantages of the many electric appliances and devices now available which go to increase the comfort of living and to relieve drudgery. In making these changes we are in a sense making an experiment, but it was our judgment that it was a wise step to make and that in a few years the results in increased sales will justify this decision.

There were two general changes made in the rates. First, a change in the form of the lighting rates applicable to all electric lighting service, commercial as well as domestic; second, a change in the form of the rate schedule which is offered for combination electric service in the home, that is, a combination of lighting, heating, cooking and appliance uses. As a result of these changes, the lighting and domestic consumers on the Pacific Gas and Electric Company's system will save approximately \$1,770,000 a year. In San Francisco the consumers will save \$585,000, and the consumers in Oakland, Berkeley and other East Bay cities, \$420,000. In the incorporated cities outside of San Francisco and the East Bay territory, the saving will amount to \$340,000 a year and the rural sections will profit to the extent of \$220,000 annually. Additional savings will accrue to California Telephone and Light consumers amounting to \$125,000 a year, and to the Western States consumers \$80,000 a year.

Under the new schedule for lighting service, the old minimum charge of 90 cents in San Francisco and East Bay territory has been eliminated and in its place there has been substituted a service charge of 40 cents per month. The initial or top rate for electrical energy used has been reduced to 5 cents a kilowatt-hour, thus absorbing the service charge even for relatively small users.

In cities and towns other than San Francisco and those of the East Bay territory, the minimum charge of \$1 is replaced by a service charge of 50 cents. In unincorporated territory the minimum charge of \$1.25 is superseded by a 70-cent service charge. Top rates in all territory affected are cut in the same amount as the reduction made in San Francisco, that is one cent per kilowatt-hour.

The new lighting schedules were made effective automatically on the first of March and during the month the new combination rates covering general household use were offered to every consumer. Application must be made for the latter rate as, to obtain it, consumers must have electric appliances aggregating at least one kilowatt capacity. This is a modest requirement, and does not necessitate the installation of more than two or three ordinary household appliances.

The extent of the reduction can best be appreciated by comparing old bills with what will be paid hereafter for the same consumption of current. Taking San Francisco and the East Bay territory as an example, the average householder's consumption is now about 30 kilowatt-hours a month. Under the old rate this householder paid \$2.10. Under the new lighting rate he will pay \$1.90, a saving of \$2.40 a year, or more than the amount of one month's bill under the old schedule.

A far greater saving can be made under the combination rate. For instance, a householder residing in a dwelling of six rooms or less who has been using an average of 50 kilowatt-hours has been paying \$3.30 a month, but under the new combination rate he will pay only \$2.60 a month, a saving of \$8.40 a year, making the reduction greater than the amount paid for two and a half months of service under the lighting rate. The saving in other territory will be in similar proportion.

As all the new lighting rates and new combination rates include a service charge which is the same regardless of the amount

of energy used and which is charged even if no energy is used, a word of explanation of the service charge seems appropriate, particularly as this form of charge is an innovation in our method of billing for electric service although it is quite widely and generally used elsewhere for electric, water and gas service, as well as in this territory for water service.

That there should be either a minimum or a service charge each month is quite apparent when it is considered that the company in supplying electric service to a home incurs certain expenses regardless of whether or not the consumer makes use of that service. In other words, there are certain classes of expenses that the company incurs each month which are entirely independent of the amount of energy used by the customer. Many of these expenses are incurred even if no use is made of the service during the month, such items of expense as, for instance, the reading of the meter. It is necessary for one of the company's meter readers to call each month and read the meter. This meter reading is then reported to the office and a bill is made out passing through the regular routine in the various departments, and then is turned over to the proper department for delivery to the consumer. All of these expenses are of course independent of whether the customer has used one kilowatt-hour or one hundred kilowatt-hours during the month. In addition to these expenses, there are the costs which are connected with the supplying of service to the customer's house. The company not only has a certain amount of investment in its pole lines, wires and equipment on the streets which are used to bring the energy from its stations to the vicinity of the customer's house but, also, has its specific investment in its service wires and meters which serve no other purpose than supplying service to the particular customer. All of those lines and items of equipment have cost money to install, which, of course, means interest charges, and, in addition, they must be maintained in good condition, repaired when necessary and must be replaced when they wear out entirely.

Let us suppose that there were no service charge or minimum charge and one of our customers were away for six months. This would mean that the meter would have to be read each month during the six-month period and the company would have to

maintain the service and meter in the customer's house in good order, receiving, meanwhile, no compensation whatever for these services. The idea, then, behind the customer's charge of 40 cents per month is to insure the company some compensation for these services which are entirely independent of the amount of energy used by the customer.

Lighting and domestic rates in effect in the territory of the Pacific Gas and Electric Company prior to the latest reduction were known as the L schedules, designated as L-1, L-2, and L-3, and covered the lighting and ordinary domestic uses. The numbers signified the rate zones. The first zone covered the San Francisco bay territory, the second zone all of the incorporated cities outside of the bay area, the third zone the unincorporated territory throughout the great area served by the company. The numbers that followed the letter designation of the schedule, therefore, indicated the first, second and third zones.

There was also in effect a combination lighting, cooking and heating schedule for domestic purposes which was available only to domestic consumers having at least two kilowatts of major cooking or heating equipment installed, and the consumer was required to guarantee a minimum return to the company of at least \$3.00 per month. This schedule was designated as C-2 and was effective throughout the whole system.

The new lighting schedules are also known as L-1, L-2 and L-3, and are effective in the three rate zones previously mentioned. These schedules were made effective March 1st and all consumers who were on the old L schedules were automatically transferred to the new lighting schedules.

The superseded L-1 schedule which was in effect in the San Francisco bay area called for 90 cents for the first 10 kilowatt-hours or less, 6 cents a kilowatt-hour for the next 40 kilowatt-hours, 5 cents for the next 140 kilowatt-hours; and so down to a minimum rate of $2\frac{1}{2}$ cents. The new L-1 schedule contains a service charge of 40 cents per month for each consumer plus an energy charge which is added to the service charge in determining the bill. The energy charge is 5 cents per kilowatt-hour for the first 200 kilowatt-hours per month, and 4 cents per kilowatt-hour for the next 800 kilowatt-hours. This schedule, like the one it superseded, reaches a minimum of $2\frac{1}{2}$ cents.

The second rate zone, in which schedule L-2 applies, has a service charge of 50 cents per month and the same energy charges that are in effect in the first rate zone.

In the third rate zone, which includes all the unincorporated territory, the L-3 schedule applies and the service charge is 70 cents in addition to the energy charge. The maximum energy rate in this zone is 6 cents and the minimum rate is $3\frac{1}{2}$ cents per kilowatt-hour.

In order to provide for those domestic consumers who use appliances of the lamp socket type, three new schedules were prepared which are designated as D-1, D-2 and D-3, superseding schedule C-2, which applied to the whole system. The numbers also denote the rate zone in which the schedule is applicable, and the zonal division is the same as that already described in the explanation of the L schedules.

Service charges under the D schedules are the same as those on the lighting schedules. The maximum rate for energy will be the same, that is, 5 cents in zones 1 and 2, and 6 cents in the third zone. The D schedules differ from the L schedules, however, in that the second block charge will be $3\frac{1}{2}$ cents per kilowatt-hour and that of the third block $1\frac{1}{2}$ cents in all three zones. They also differ from the old C-2 schedule, which covered domestic combination service in that it is not necessary, in order to obtain the benefits of this schedule, to install any major heating or cooking equipment. These schedules are available upon application to any consumer having at least 1000 watts of lamp socket, heating or cooking appliances. A consumer with any two of the usual lamp socket appliances, such as toaster, flatiron, washing machine or small electric heaters, may qualify for the D schedule and upon application will be given the benefit of this particularly low rate.

The D schedules offer a very low rate for energy used in the home for electrical appliances and general lighting. The first 30 kilowatt-hours per meter per month cost but 5 cents per kilowatt-hour in the D-1 and D-2 zones and only 6 cents in the D-3 zone. The first block of 30 kilowatt-hours applies to houses of six rooms or less. When the house is larger than six rooms, 5 kilowatt-hours are added to the top block for each active room. After the first 30 kilowatt-hours for houses of six rooms or less, the next block is 140 kilowatt-hours at $3\frac{1}{2}$ cents

per kilowatt-hour. All consumption over 170 kilowatt-hours per month will be billed at $1\frac{1}{2}$ cents per kilowatt-hour.

Average use of electricity for residential service in San Francisco approximates 30 kilowatt-hours per month, which is equivalent to the first block. This means that there is available to the average consumer energy at $3\frac{1}{2}$ cents per kilowatt-hour for additional lighting or for any of the ordinary uses in the home, and if the use is substantially such as would be necessary for heating and cooking and the liberal use of appliances the

additional energy may be had at $1\frac{1}{2}$ cents.

After studying the experience of other electric utility companies with the various forms of rate schedules, we believe that our new schedules will make for better satisfied consumers and that this type of schedule will encourage the greater use of electricity in the home than the form of schedules heretofore in effect in our territory.

The following table shows that not only the rate for ordinary lighting uses has been reduced, but also that energy for additional uses is available at a very low cost:

COMPARISON OF OLD LIGHTING SCHEDULE (L-1) AND NEW DOMESTIC SERVICE SCHEDULE (D-1)

Monthly Use Kilowatt-Hours	Old Lighting Schedule	Additional Use	New Domestic Service Schedule (D-1) 6-Room House or Less	Additional Use	*New Domestic Service Schedule (D-1) 7-Room House	Additional Use	*New Domestic Service Schedule (D-1) 8-Room House	Additional Use
1	\$.90		\$.45		\$.45		\$.45	
5	.90		.65		.65		.65	
10	.90		.90		.90		.90	
15	1.20		1.15	-5c per kilowatt-hour	1.15		1.15	
20	1.50		1.40		1.40	-5c per kilowatt-hour	1.40	-5c per kilowatt-hour
25	1.80		1.65		1.65		1.65	
30	2.10	-6c per kilowatt-hour	1.90		1.90		1.90	
35	2.40		2.08		2.15		2.15	
40	2.70		2.25		2.33		2.40	
50	3.30		2.60		2.68		2.75	
60	3.80		2.95	-3 $\frac{1}{2}$ c per kilowatt-hour	3.03		3.10	
80	4.80		3.65		3.73	-3 $\frac{1}{2}$ c per kilowatt-hour	3.80	-3 $\frac{1}{2}$ c per kilowatt-hour
100	5.80		4.35		4.43		4.50	
125	7.05	-5c per kilowatt-hour	5.23		5.30		5.38	
150	8.30		6.10		6.18		6.25	
170	9.30		6.80		6.88		6.95	
175	9.55		6.88	Over 170 kilowatt-hours per month -1 $\frac{1}{2}$ c per kilowatt-hour	7.05	Over 175 kilowatt-hours per month -1 $\frac{1}{2}$ c per kilowatt-hour	7.13	Over 180 kilowatt-hours per month -1 $\frac{1}{2}$ c per kilowatt-hour
180	9.80		6.95		7.13		7.30	
200	10.80		7.25		7.43		7.60	

*5 kilowatt hours added to first block of 30 kilowatt hours for each additional room over six rooms.

Under the old lighting schedule, L-1, a consumer residing in a 6-room house paid 7 cents per kilowatt-hour for the first 30 kilowatt-hours per month, while the next 20 kilowatt-hours would be billed at the rate of 6 cents per kilowatt-hour. Under the new domestic service schedule, D-1, the first 30 kilowatt-hours will be at 5 cents per kilowatt-hour and the next 20 kilowatt-hours at the rate of $3\frac{1}{2}$ cents, as compared with 6 cents under the old lighting schedule.

As before stated, these sweeping reductions will result in a very considerable loss of income to the company. It devolves, then, upon our company's sales organization to offset, as far as possible, this loss by an ag-

gressive campaign for the development of business throughout the entire territory served by the company. Utilities of the present day with their tremendous investments are in competition with all modern selling organizations and organized industries who are overlooking no opportunity to tell their story to the public. Pacific Gas and Electric Company believes that it is rendering a decided service to its consumers in pointing out to them the convenience of modern gas and electric appliances while, at the same time, following a proper business policy in endeavoring to sell more of its commodity on its existing gas and electric lines.

Improvements in Gas Service Result of Constant Experiment

In the never-ending task of improving service to the consumer, research work in the Gas Department was actively carried on during 1927. The work was not confined to any major subject but, rather, toward a cleaning up process in finishing the numerous tag ends that have hung over from previous years. A number of interesting developments, however, were worked out by various groups and individuals in the organization which, although not spectacular, are quite important and with time will find very useful application. These include determination of heat transfer coefficients and rates of water flow in grid-packed towers for cooling gas containing various amounts of water vapor; a new scrubber spray; application of liquid purification to scrubbers at outlet of generators; the use of extra air to accelerate actification of the soda-ash solution used in purifying gas; the preparation of sulphur for the market; the utilization of lampblack and tar; special tests upon residuum oil for gas making, and a new scheme of distributing gas-making oil in the generators.

A very complete series of tests with specially designed apparatus was conducted at the Potrero plant for the purpose of determining coefficients for heat transfer from gas to water in the grid-packed towers. The literature available contained information upon such coefficients only as applied to dry gas, whereas the gas entering our scrubbing systems contained a large amount of water vapor, so that it became saturated at about 170° F. It is known that the coefficient of transfer from condensing steam is approximately 2000, whereas for dry gas it is in the neighborhood of 2; consequently, it can be expected for gases containing large amounts of condensed water vapor that the rate of heat transfer will lie somewhere between these two figures, and an accurate knowledge of the coefficients to be obtained was deemed necessary in order to properly design efficient scrubbers. The results were very satisfactory and are being applied in the present construction work. Scrubbers of smaller diameter and greater height will now be used and fewer will be needed.

During this work, the effects of various rates of water flow were also determined, so that it is now possible to standardize upon the amount of water used per square foot for various types of grid packing. With scrubbers of smaller diameter and the adoption of the recirculating system which had previously proven satisfactory, the amount of scrubbing water and, therefore, the amount of waste water, is much less, thus reducing the amount of separating and filtering equipment necessary. Where scrubbing systems are already installed, the application of the new principles will make available some of the existing scrubbers for use as liquid purifiers when the growth demands.

From the study of rates of water flow and from previous work on liquid purifiers it became evident that a better spray was required to give satisfactory distribution over the entire cross section area of the towers. Such a spray was developed and is now in use in several of the plants. A more even distribution of the water or soda-ash solution over the trays has given a noticeable improvement in condensation in water scrubbing and hydrogen sulphide removal in liquid purifiers. One of the principal objections to the sprays in the market is their inability to withstand corrosion from salt water, and a second objection is that the greater number of them throw a very fine spray which is carried over with the gas. The new spray is composed of cast iron and gives a coarse rain which is not entrained by the gas stream.

In San Rafael, the gas load had increased until the capacity of the oxide purifiers was exceeded. It was decided to convert the last water scrubber into a liquid purifier, expecting thereby to partially purify the gas ahead of the oxide boxes. The scrubber was equipped with the new sprays and rates of solution flow calculated from the results of the tests mentioned above. When placed in operation, the removal of hydrogen sulphide from the gas in the single unit was in the neighborhood of 90 per cent, so that it now constitutes the principal part of the purification plant instead of being only an

auxiliary thereto. This was a direct application of the data obtained and has demonstrated the possibilities of revamping the scrubbing systems to obtain better water scrubbing and, also, make available some of the present equipment for the removal of sulphur compounds.

During the past year the Research Department did a valuable amount of work upon ways and means of preparing sulphur to meet the various conditions which may be required for different marketing outlets, and it is probable that sufficient work has been done to proceed with the preparation in any direction that the market may be developed. A specialist in entomology from the University of California was employed in this connection. He studied the market and supervised the distribution and application of a great number of samples.

Another line of work was directed toward the utilization of lampblack, with the idea of preparing it for more efficient use as a boiler fuel, where it is at present consumed, and, also, for the manufacture of briquettes and other products which can be utilized by various industrial concerns. Lampblack also has potential development as a fuel to be used in the actual generation of water gas. Most of this work had in mind the laying out of a future program rather than the development of any process for immediate application. Out of it, however, has come the disposal of considerable excess lampblack and char to orchardists for fuel purposes.

Special research work was also done upon the water-gas tar produced at the Marysville gas plant, and from this there is now being prepared a fifty-fifty mixture with coal tar which had accumulated at the old North Beach station. This mixture is quite satisfactory for a great many purposes and is finding a ready market.

In co-operation with the oil company, a series of special cargoes of oil was delivered to the Potrero plant late in the year. These sample shipments were used in the gas generators in the regular routine, but special observation of the manufacturing conditions was recorded and thorough analyses of the oil and gas were made. The purpose of these large scale experiments was to determine, in a practical way, which of the residuum oils available were best for gas-making purposes. The data obtained has been instructive and is of a nature that could have been obtained in no other manner.

During the past year employees at the San Jose gas plant found that by introducing compressed air into the solution at the inlet of the emulsifiers of the liquid purification plant the actification was improved about 30 per cent. Shortly after this, the employees at the San Rafael plant found that by circulating air with a fan over the surface of the solution in the emulsifier, actification was improved. These two ideas, particularly the first one, are quite useful, as the cost of the additional air is low and may serve in many instances to increase the capacity of installed equipment during peak loads or when a portion of the apparatus is under repairs.

A new thought in regard to the distribution of manufacturing oil used in gas generators was developed by the superintendent of the Chico plant. Instead of introducing all of the make oil into the make chamber, a portion of it was introduced into the chamber formerly used for superheating steam, thus, instead of concentrating the oil sprayed upon a limited area of checkerbrick, the same amount of oil was sprayed upon approximately twice the area. The result obtained was a lower consumption of oil and apparently a longer life of checkerbrick.

The superintendent of the Vallejo plant had previously done the same thing and found a reduction in oil consumption, but feared the effect upon the checkerbrick. Recently, a second test at Vallejo indicated a substantial reduction in oil consumption. If further tests bear out the indications thus far shown, this scheme will find quite wide application. It is doubtful, however, whether the same results would be obtained from experiments upon large generators where the efficiency is already high. At any rate, the oil consumed upon the small machine at Chico is lower than was obtained before on that size machine and this principle may be applied to other small generators.

While the improvements and research for the past year do not cover an intensive investigation along any major line, it is very gratifying to note such a variety of improvements and the fact that they are coming from employees over a great portion of the system. If it is possible to encourage all of the employees to work and observe thoughtfully, it is probable that a much larger number of improvements may be listed year by year.

Housekeeping on Company's Properties--- Awards for Orderly Care and Attention

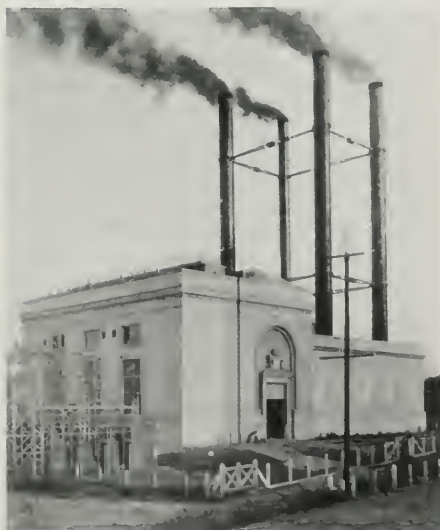
The Merit Plan and System of Awards instituted by our company's management as an encouragement to good housekeeping is producing excellent results. There has been a marked improvement in the appearance of the company's properties during the past year. Many have lawns, trees, shrubs, vines, even flowers that would do credit to the average man's home garden. Indeed, the care of the buildings and equipment shows such interest and attention on the part of attendants as one usually finds only in individuals when caring for their personal property. To the spirit in which this system was inaugurated the employees have responded wonderfully. Their interest seems really personal and the



Substation "I," Oakland, East Bay Division. First award among properties controlled by the Department of Electrical Construction and Operation, and the highest rating of any property visited.

extra effort has been voluntary. It seems as if they have been anxious to do these things and needed only official sanction.

Awards are made to the properties receiving the highest rating in each class and to those most presentable, regardless of class. In the case of properties in the Electric Department, these awards consist of bronze plaques for display inside the buildings and larger easel-mounted signs for display out of doors. Gas Department properties receive certificates signed by the President, Vice-President and General Manager and the Vice-President in Charge of Gas Construction and Operation. In the office buildings the awards take the form of a gold leaf window transfer indicative of the rank achieved. These awards are not monetary and, therefore, do not partake of the nature of a bonus in order to induce extra work, but, rather, are an expression of personal appreciation from the officials to the employees. The results to be obtained from a comparison toward better housekeeping are: first, the working conditions are better; an orderly and clean plant is a safer and healthier place to work in; second, a property of good appearance is an expression not only of pride in itself but, also, of good will to the community in which it is located.



Station "B," Sacramento, first prize among steam-electric stations.

A fair system of inspection and rating is very difficult. The construction program during the past six or seven years has completely reorganized and practically rebuilt many of the properties, so that they are modern, well arranged and in very good physical condition. At a few locations, the rate of growth or other conditions have not warranted so much expenditure and in still others the arrangement of apparatus was such as to require too much expense or the plant was too far developed along present lines to reconstruct into a modern layout.

In the present scheme it is attempted to remove the personal element in rating as much as possible. The instructions given to the committee attempt to point out an attitude which will give the various properties, as near as possible, a fair chance of winning. A portion of these instructions is as follows:

"The age, obsolescence or relative importance or capacity of the properties are not to be considered as factors in establishing the rating, emphasis being placed upon such conditions as are under control and dependent upon the interest, attention and efforts of the attendants. Care should be taken not to deduct merits on account of temporary conditions due to construction or experimental work conducted by parties not under control of the attendants. Deductions should not be made for temporary conditions due to cleaning or repairs, where sufficient time has not elapsed for their removal. Due consideration should be given to operating conditions at time of inspection. In many plants there are periods in the day's work during which dirt may accumulate but which is removed in regular sequence of the day's routine; however, where there is evidence that such accumula-



South Power House, on South Battle Creek, Shasta Division. First award among hydro-electric plants.

tions have remained an unreasonable time deductions should be made."

While these inspections allow some latitude in certain conditions about the properties, the details of the rating schedules clearly show that to obtain a high standing all parts of the property under inspection must be clean, orderly and in repair. Each type of equipment or portion of the property has certain features to which special attention is given and the relative number of merits obtainable for perfection varies with its nature and possibilities.

This premium system was initiated by the Department of Electrical Construction and Operation, and the year 1927 was its second year of awards. Under its plan the properties are divided into three classes, electric substations, steam stations and hydro plants. Following are the subdivisions of property, with the maximum merits obtainable for each:



Gas plant at San Rafael, North Bay Division. First prize.

Subdivision A., grounds, maximum merits obtainable, 150; *B.*, buildings and structures, 200; *C.*, employee attendants, 25; *D.*, records, 25; *E.*, materials, supplies, tools, equipment, 150; *F.*, stationary electrical equipment, 150; *G.*, rotating electrical equipment, 100; *H.*, hydro prime-mover equipment, 150; *I.*, hydraulic structures and equipment, 100; *J.*, steam prime-mover equipment, 150; *K.*, steam boiler equipment, 100.

Owing to the large number of properties under control of this department, too much time would be required for one committee to inspect them all. To minimize the time and labor, each division of the "Pacific Service" territory appoints its own rating committee which inspects all stations in that division; the general rating committee then inspects three or more stations in each division and out of these it selects the three highest ranking stations on the system.

It is noteworthy that the size, importance, or newness of the stations inspected was not effective in determining the winners, but almost entirely the evidence of continuous thoughtfulness and effort as to cleanliness and order on the part of the employees at the plant. It is also interesting to note that in both this and the preceding year the prize-winning stations were widely spread among the divisions.

The Gas Department properties are divided into three territorial sections, each

having a sectional committee, composed of one member from each of the company's divisions within the section. These three committees visit and rate all the properties in their territorial section and submit their report to the vice-president in charge of the department having jurisdiction of the particular class of properties adjudicated upon, and he, in turn, appoints a general rating committee whose duty is to review the ratings submitted by the sectional committee and then make such final inspections as are necessary to pick the winners. Following are two subdivisions of the rating schedule:

Subdivision B. Buildings. Roof, walls, floors, doors, etc., in repair, merits obtainable, 15; fittings, plumbing, etc., in repair, 15; wiring (slightly, permanent, safe), 10; surfaces painted, 20; painted surfaces (not worn nor marred), 30; bright surfaces polished, 10; floors, walls, or ceilings (no dust, dirt, oil, stains, smoke, markings), 20; windows (clean and unbroken), 40; screens (not broken nor rusty), 10; lamps and fixtures (clean and unbroken), 20; miscellaneous, 10.

Subdivision I. Generators. Surfaces painted, merits obtainable, 15; painted surfaces (not worn nor marred), 15; no leaks (gas, oil, steam or air), 30; control meters and gauges (clean and operating), 15; operating sheets (orderly and clean), 10; explosion heads in blast lines and washbox in good condition, 10; sight cocks in operating

condition, 15; no accumulation of tar, lampblack or rubbish, 15; other repairs not neglected, 15; miscellaneous, 10.

To reach a high degree of excellence under these rating schedules necessitates not only a little more than ordinary care on the part of the attendants, but also, more than passing interest on the part of the local management. There must be a judicious use of money as there must be paint, polish, rags, packing, tools, shrubs, flowers and seeds, and there must occasionally be extra help for disposal of rubbish, leveling of ground and similar work. The co-operation of construction crews in making neat, attractive and tight installations, and in the prompt removal of excess material or debris is of considerable importance. Only the management can control this through its supervision and direction. Thus, while good housekeeping is usually laid at the door of the operating employee in charge, *first prize housekeeping* is obtained only through co-operation and active interest all along the line.

Such success as was achieved during the past year demonstrates that this co-operation can be secured and those who have made the effort are well satisfied with the results. As always, further improvements are possible and present indications are that competition during the present year will be much keener than during the past.

The application of the merit system to office buildings all over the "Pacific Service" territory has proved thoroughly worthwhile. The general rating committee appointed by the Vice-President in Charge of Public Relations and Sales made a thorough inspection of all office properties and co-operated with the district committees in making the awards.

The following awards were made for good housekeeping in the various company properties during 1927:

Department of Gas Construction and Operation.

Production Plants. First place, San Rafael, North Bay division; second place, Sac-



Our Company's office building at Fresno. First award.

ramento, Sacramento division; third place, Salinas, Coast Valleys.

Holder Stations. First place, Santa Rosa, North Bay division; second place, Oakland-Fiftieth Avenue, East Bay; third place, San Leandro, East Bay.

Meter and Regulator Shops: Class "A." First place, San Rafael, North Bay division; second place, Sacramento; third place, San Jose. Class "B." First place, Santa Rosa, North Bay; second place, Salinas, Coast Valleys; third place, Grass Valley, Nevada.

Department of Electrical Construction and Operation.

Electric Substations. First prize, Station "I," East Bay division; second, Mountain View, San Jose; third, Santa Rosa, North Bay.

Steam Stations. First prize, Station "B," Sacramento; second, Station "S," San Francisco; third, North Beach, San Francisco.

Hydro Power Plants. First prize, South, Shasta division; second, Spring Gap, San Joaquin; third, Colgate, Colgate.

Department of Vice-President in Charge of Public Relations and Sales.

Division Offices. First prize, Fresno; second, Oakland, East Bay division; third, Salinas, Coast Valleys.

District Offices. Woodland, Sacramento division, first; Jackson, San Joaquin, second; King City, Coast Valleys, third.

Agency Offices. Newman, San Joaquin division, first; Antioch, East Bay, second; Sausalito, North Bay, third.

The Financial Side of "Pacific Service"

Following is a statement of the Company's earnings for the three months ended March 31st, 1928:

	3 Mos. to March 31, 1928	Increase
Gross Revenue (including Miscellaneous Income).....	\$14,948.009	\$668,965
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals and Reserves for Casualties and Uncollectible Accounts..	7,920.361	19,044
Total Net Income.....	\$ 7,027,648	\$649,921
Bond Interest and Discount.....	2,212.284	228,002*
Balance	\$ 4,815,364	\$877,923
Reserve for Depreciation.....	1,337,316	123,228
Surplus	\$ 3,478,048	\$754,695
Dividends Accrued on Preferred Stock (6%).....	1,160,127	190,183
Balance	\$ 2,317,921	\$564,512
Dividends Accrued on Common Stock (8%).....	1,293,554	228,889
Balance	\$ 1,024,367	\$335,623
*Decrease		

Gross revenues of affiliated companies, amounting to \$1,330,000 for the first quarter, are not included in the foregoing statement which, however, does include, as a part of miscellaneous income, surplus profits of \$145,418 applicable to the Company's investment in these affiliated companies.

Decreased interest charges are in part a reflection of the saving effected as of December 1, 1927, by means of the issuance of a 4½% bond issue to retire other issues bearing higher interest rates. Included in the retirement were \$10,720,000 par value of First and Refunding 7% Bonds.

Surplus after the deduction of operating expenses, fixed charges and depreciation reserve was \$3,478,048, of which preferred stock dividends absorbed \$1,160,127, leaving a balance of \$2,317,921, equivalent to 3.58% on the average amount of common stock outstanding during the quarter. This compares with 3.29% in the corresponding quarter of 1927.

As of March 1st, our customers, chiefly in the residential and commercial classes, were given the benefit of reductions in both gas and electric rates approximating \$180,000 per month. Lower oil costs, reduced money costs and other economies will offset these reductions to a substantial degree. Our experience has also demonstrated that increased usage follows the lowering of rates, and we anticipate that this accelerated growth, aided by an energetic sales campaign, will, within a reasonable period, compensate for loss of revenue occasioned by the lower rates.

PAR OFFERINGS OF COMMON STOCK

There appears to be a growing appreciation on the part of the Company's common stockholders of the subscription privileges which have been offered annually during each of the past three years. These "par offerings" have permitted holders of the Company's common stock to purchase additional common, at par, in the proportion of one share of

new stock for each ten shares held. In 1926 subscriptions were entered for 98.33% of the stock so offered, in 1927, 98.72%, and in 1928, 99.50%. The average market value of these subscription rights, based on prices at which the rights were dealt in on the New York and San Francisco Stock Exchanges, was equivalent to 2.35%, 2.43% and 8.08% respectively upon each \$100 par value of common stock outstanding at the time when the subscription privilege became operative. The aggregate value placed upon these rights by the market during the past three years, on the same basis, was \$7,634,000.

The following tabulation gives the details of these par offerings and indicates the monetary value of the subscription privileges each year on the basis of stock market quotations:

Par Offering No.	Date Offering Effective	Par Value of Stock Offered to Common Stockholders	Subscriptions Received		Value of Rights based on Average Market Prices	
			Par Value	% of Total Offering	Amount	% of Total Common Stock
1	2-23-26	\$4,813,084	\$4,732,500	98.33%	\$1,131,000	2.35%
2	1-26-27	5,285,915	5,218,200	98.72%	1,285,000	2.43%
3	2-17-28	6,458,350	6,425,900	99.50%	5,218,000	8.08%

PENSIONS

This Company for many years has followed the practice of granting pensions to aged employees in recognition of long and faithful service. Generally speaking, any male employee attaining the age of 65 years and any female employee reaching 55 years of age, after fifteen years of continuous service, may be retired on a pension by the Executive Committee acting on its own motion, or on the employee's application. Employees who, after twenty years' continuous service, may become permanently incapacitated, are also entitled to pensions even though they may not have reached the specified age limits.

In the past fifteen years, \$505,624 has been paid to superannuated employees, of which \$65,042 was disbursed in 1927. Eighty-three employees were enjoying pension rights at the close of last year, of whom one had been receiving a pension for approximately fifteen years and the remainder during periods ranging from less than one year to eleven years. The following table shows the pension disbursements from 1913 to 1927 inclusive, the average monthly pension paid to each employee and the average age of employees when pensioned:

Year	Average No. of Pensioners on Payroll	Total Pensions Paid	Average Monthly Pension	Average Age of Pensioner
1913	15.7	\$ 5,603.94	\$50.95	74.6 Yrs.
1914	20.3	11,288.54	46.35	63.2 "
1915	24.7	12,929.44	43.45	72.3 "
1916	25.0	13,274.16	44.20	65.3 "
1917	40.0	21,984.91	45.75	62.7 "
1918	52.9	27,585.71	43.45	61.6 "
1919	54.5	28,261.16	43.20	68.6 "
1920	59.0	30,254.14	42.70	59.5 "
1921	62.3	33,389.04	44.65	67.1 "
1922	63.7	43,067.41	56.35	66.9 "
1923	72.2	49,780.62	57.45	60.8 "
1924	73.5	50,241.02	56.95	69.4 "
1925	78.9	55,061.06	58.15	69.4 "
1926	77.4	57,860.53	62.30	64.1 "
1927	84.8	65,042.45	63.90	65.9 "
Total.....		\$505,624.13	Average \$52.78	Average 66.0 "

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII APRIL, 1928 No. 4

The weather conditions which prevailed throughout Northern and Central California during the last week in March of this year furnished ample verification of the old saying concerning this blustery and uncertain month. Not only did torrential rains drench the lowlands but, due to the very moderate temperatures existing at higher levels, the liberal precipitation over the Sierra slopes fell as rain instead of snow and very materially hastened the melting of the icy coating left by last winter's storms.

The sudden release of vast quantities of surface water in this manner occasioned a very rapid rise of all the streams supplied from Sierra sources and produced mildly spectacular floods in the Central California valleys. Fortunately, the high water period was of short duration, the crest of the flood lasting only a few hours. Property damage, however, was considerable, and our company had its share of trouble owing to the nature and location of some of its properties. Seven of the thirty-two hydro-electric generating plants in the "Pacific Service" system were rendered temporarily inoperative; ditches and flumes were washed away or filled with rocks and debris by the torrents which rushed down every ravine along the mountain sides; poles carrying electric service wires to villages and farms in the flooded districts were washed out and carried away by the swift waters.

But, through it all the spirit of "Pacific Service" carried on. Every available man in the organization throughout the flooded districts was on the job night and day, and service was maintained continuously to almost every consumer. In the few cases where lines were washed completely away, temporary service was re-established in record time. Every available motor-launch and

rowboat was pressed into service, and constant patrols were made of endangered sections of line to insure quick repairs in case of failure.

With all this burden upon them, the men of "Pacific Service" found time to lend a helping hand to others less fortunate than they. On two occasions a crew of linemen on patrol of service lines through the flooded district found and rescued persons who had been tardy in leaving their lowland property and were marooned in tank-houses or other buildings. Twenty-five persons, in all, were so rescued. In one case of a threatened levee break, a crew of our company's workmen was able to make a temporary installation of lights along the levee, rushing the job through between 3 o'clock in the afternoon and nightfall. Our men also aided the State Highway Commission in directing traffic through Sacramento when the highway through North Sacramento was under ten feet of water.

Our company's operating force co-operated with the State Board of Flood Control in Sacramento, furnishing information which aided the board in following the course of the flood waters in their progress from the mountain sections and in predicting and preparing for the rise and overflow of the rivers in the lowlands.

Incidentally, the ditches and flumes which carry water to and from our company's generating plants, as well as the lakes and reservoirs which make up its water storage system, were of immeasurable service in modifying the effect of the flood waters on the sections where these facilities exist. Much of the excess was stopped behind the dams, and large quantities of water which would otherwise have rushed devastatingly through the small but fertile valleys of the foothills were carried harmlessly to the rivers by the diverting canals.

From statistics gathered by the United States Department of the Interior and other reliable sources of information we cull for the benefit of our readers some interesting facts concerning the progress of the electric light and power industry in this country.

During the past year the output of electric energy sold to consumers in the United States exceeded 75,000,000,000 kilowatt hours, an increase of 8 per cent over the output for 1926. Of this quantity 37 per cent was produced by the use of water

power. The number of light and power systems operating in the country was 4,409 and these served 21,694,000 customers. Their generating stations were of an aggregate capacity of 28,990,000 k.v.a. The gross revenue of the light and power industry was \$1,783,000,000 and the net was \$1,017,000,000. An appreciation of the tremendous growth of the industry in late years is afforded by the statement that in 1907 there were 1,946,979 total customers of electric companies; so that the lapse of twenty years has multiplied this figure by more than ten. In 1927 domestic customers numbered 17,596,000. About 63 per cent of the people now live in homes served by electricity.

Electrical manufacturers of heavy equipment did a gross business of about \$1,000,000,000 in 1927. Appliance and radio manufacturers did a business of about \$2,000,000,000 in this period. And, today American industry is only 75 per cent electrified.

The total investment in plants and equipment in the United States exceeds \$8,000,000,000. During 1927 the utilities spent \$760,000,000 for additional facilities, and their budget for 1928 aggregates over \$900,000,000. During the past year over \$2,000,000,000 of the securities of light and power companies were sold in the money markets, representing a quarter of the total securities sold in the United States. It is explained that investors have faith in the electrical industry because of its honorable record for honesty and service.

Turning westward, we find that during the past year 2,875,950 customers of the central stations in the eleven Western states used 13,726,565,000 kilowatt hours. Of this total it is interesting to learn that 89.5 per cent of the total generation was produced by hydro-electric plants. In California the total energy production from water-power systems alone amounted to 6,644,500,000 kilowatt hours, to which total Pacific Gas and Electric Company contributed 1,657,965,000 kilowatt hours. Additions to the aggregate generating capacity of the California electric systems during 1927 total 84,750 k.v.a., or 113,600 horsepower. The total installed capacity serving the requirements of the state now aggregates 2,198,144 k.v.a., or 2,946,570 horsepower, of which water-power plants represent a total of 1,469,144 k.v.a., or 1,969,360 horsepower.

In view of the amazing figures presented in the record of the electrical industry in this country, it is comforting to learn that electricity's hundred-year-old rival, gas, is more than holding its own as a marketable commodity. Figures collected by the American Gas Association show that the total sales for 1927 reached a new high record of 475,000,000,000 cubic feet, an increase of nearly 5 per cent over 1926 and of 36 per cent over 1922. Pacific Coast gas men may contrast these figures with the growth in their section of the country as shown by statistics presented by the Pacific Coast Gas Association. During 1927 the sales record of twenty Pacific Coast gas companies amounted to 96,841,483,000 cubic feet, an increase of 60 per cent over 1922. Some 14,000 gas ranges were sold by companies during 1927 and, also, 5,000 tank water heaters, 3,200 automatic water heaters, 6,000 space heaters, 1,000 furnaces, 200 gas-fired boilers and some 1,500 industrial appliances. All this is exclusive of dealers' sales, concerning which no accurate information is to hand; it may readily be imagined, however, that the record is an imposing one. In addition, the companies named show increases during the past five years of 48 per cent in active meters, of which there were 1,366,166 in service at the close of 1927, and 57 per cent in gross revenues, which in 1927 reached \$65,328,757. Commenting upon these figures, an editorial in *Western Gas* states:

"With the Coast section turning more aggressively than in the past to gas appliance merchandising, it does not require much optimism to prophesy that the next five years will continue the upward trend in this territory. The most important sign of the new merchandising order is the Pacific Gas and Electric Company's adoption of a comprehensive sales program which will be felt in 351 northern California communities."

Notwithstanding the fact that no large projects are under way, gas companies of the Pacific Coast will spend about \$15,000,000 in 1928 in general betterment and extensions of service.

It is interesting to learn that 181 municipally owned electric light and power generating plants or distributing systems were sold during 1927 to privately owned operating companies, to be absorbed in more economically operated interconnected sys-

tems. Municipal plants in a total of 34 states were involved in the sales to privately owned and operated concerns. In the "Pacific Service" territory two municipal elections were held during the year, one at Oroville, the other at Sacramento, at which the resident voters of those respective localities were asked to pass upon the proposed acquisition or development of public utility properties. These two elections were the only ones held during the year which provided for municipal ownership of utilities and both propositions were decisively defeated.

President Coolidge has more than once expressed his opinion upon so-called public ownership in very plain terms. Quite recently, in an address to the congress of the Daughters of the American Revolution at Washington, D. C., he gave utterance to the following:

"Public ownership leads inevitably to a position of entrenched selfishness, where a great body of public employees and large outside interests are in virtual control, with the general public paying a high cost for poor service.

"With all the care that it is possible to exercise, a situation of this kind becomes entangled in favoritism and always is in great danger of causing corruption and scandal.

"If the people are to remain politically free they must be economically free. Their only hope in that direction is for them to keep their own business in their own hands."

INDIVIDUAL EFFORT WINS (From the *New England Utility News*)

Would the United States be the nation it is today if the government had controlled and monopolized basic lines of endeavor when our nation was formed?

There are undoubtedly many advocates of public ownership of industry who actually believe that such a program would be beneficial to the public. If we can judge by what has happened in other nations under public ownership of industry, however, during the past 150 years, the answer is emphatically, No.

Then why flirt with public ownership here? We have seen it tried by the government with our merchant marine and railroads, and in each instance the deficits have been tremendous and the service questionable.

Public ownership cannot do the impossible—stretch a dollar beyond its actual purchasing power. Men will work no cheaper for government than they will for private enterprises. Quite often the reverse in the case of like service.

In considering proposals to put the government into business, it is well to repeat the basic question: Would such a system have developed our country as it is today? Would bureaucratic control have stretched railroads from coast to coast? Would it have developed the telephone? Would it have pioneered in automobiles, airplanes and radio? Would it have brought about widespread use of electricity? Would government have exerted itself in the beginning to give the people these advantages?

Again the answer is, No, if other countries where government ownership prevails are used as a basis for comparison. Then why consider stepping backward rather than forward in this nation?

ELECTRIC FARMING ABROAD (From the *Fresno Bee*)

The French and Germans are reported to be using electricity instead of fertilizer to promote the growing of farm and garden products, and with remarkable success, four crops a year being reported in some instances, and producing fruits and vegetables three times their normal size.

The nature of the apparatus employed is still largely a mystery, but it is promised that within a year all will be made public.

There is nothing inherently improbable about this story. Experiments with ultraviolet rays and other invisible radiations have already proved that both light and electricity are important factors in plant growth. It may well be that a more direct application of electricity to the soil through wires will produce results.

Fertile as man's inventive genius has proved in some ways, he has barely begun to apply it to agriculture which, though it is the world's basic industry, is conducted much as it was 1,000 years ago.

It is quite possible that some day in the relatively near future the farmer, when he wishes to fertilize his fields, will simply turn a switch. The wonders and uses of electricity have probably been hardly tapped as yet.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 967,000 CONSUMERS OF
GAS * ELECTRICITY * WATER * STEAM
 2,515,901 Total Population Served in Thirty-eight of California's Counties
 CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity	310	1,750,272	37	164,675	347	1,914,947
Gas	84	1,781,375	5	14,702	89	1,796,077
Water (Domestic)	20	24,100	4	18,500	24	42,600
Railway	1	105,000	.....	.....	1	105,000
Steam Heating	2	1,003,000	.....	.....	2	1,003,000

Place	Population	Place	Population	Place	Population	Place	Population
Acampo.....	1,000	Coyote.....	250	Hollister.....	4,500	Newark.....	1,100
² Agnew.....	125	Crockett.....	2,500	Honcut.....	500	⁵ Newcastle.....	750
¹ Alameda.....	35,140	Crows Land.....	.....	Hopland.....	500	Newman.....	1,250
² Albany.....	6,000	ing.....	300	Hughson.....	625	Niles.....	1,850
Alamo.....	100	² Daly City.....	6,500	Hydesville.....	200	Nord.....	60
Alleghany.....	300	Danville.....	500	Inverness.....	215	Notoma.....	200
Alta.....	100	Davenport.....	500	⁵ Ione.....	900	^{2,6} Novato.....	1,000
Alton.....	200	² Davis.....	1,750	Irvington.....	1,200	North Sacra- mento.....	2,500
Alvarado.....	1,120	Decato.....	60	^{5,8} Jackson.....	2,500	Oakdale.....	2,000
Alviso.....	640	Dayton.....	700	^{5,6} Jamestown.....	1,000	Oakland.....	295,000
⁵ Amador City.....	750	⁶ Del Monte.....	300	Jenny Lind.....	100	Oakley.....	300
Anderson.....	1,180	Denair.....	400	Junction City.....	50	Oakwood.....	300
Angel Island.....	500	Diamond.....	300	Kelseyville.....	600	Oceidental.....	600
Antioch.....	2,800	Spring.....	200	Kennett.....	492	Olema.....	155
Applegate.....	100	Dixon.....	1,200	² Kentfield.....	1,000	Orland.....	2,100
⁶ Aptos.....	200	Dobbins.....	100	Kenwood.....	300	^{2,8} Oroville.....	7,000
Arbuckle.....	900	Drytown.....	200	Keswick.....	20	Pacifica.....	300
Arcata.....	2,200	Duncan's.....	.....	⁵ King City.....	1,600	² Pacific Grove.....	5,000
Artois.....	200	Mills.....	250	Kingston.....	100	^{6,7} Palo Alto.....	9,550
Asti.....	100	Durham.....	600	Knights Ferry.....	200	Paradise.....	600
² Atherton.....	800	² Dutch Flat.....	400	Knights Land- ing.....	525	Patterson.....	700
⁵ Auburn.....	3,000	Dunigan.....	150	La Fayette.....	300	Pebble Beach.....	300
Bangor.....	50	Eldridge.....	500	^{5,1} La Grange.....	200	² Pena Grove.....	250
Banta.....	50	² El Cerrito.....	3,000	Lakeport.....	1,250	² Penryn.....	250
² Barbaro.....	500	El Dorado.....	60	Larkspur.....	1,000	Perkins.....	50
² Belmont.....	1,000	Elk Grove.....	1,450	Lathrop.....	300	² Petaluma.....	7,500
Belvedere.....	750	Elmira.....	300	Lawndale.....	60	² Piedmont.....	9,000
Benicia.....	2,750	El Verrano.....	500	Lewiston.....	100	^{6,7} Pineole.....	1,000
⁶ Ben Lomond.....	500	² Emeryville.....	5,000	^{5,8} Lincoln.....	2,000	Pittsburg.....	8,500
² Berkeley.....	80,000	Empire.....	250	² Live Oak.....	1,000	Pleasanton.....	1,800
Bethany.....	50	Escalon.....	700	Livermore.....	3,600	Plymouth.....	400
^{2,6} Biggs.....	750	Eureka.....	20,000	Lockeford.....	500	Point Reyes.....	310
² Big Oak Flat.....	150	Eureka.....	20,000	^{2,6} Lodi.....	5,000	Port Costa.....	600
Blue Lake.....	500	Fairfax.....	1,200	Loleta.....	800	Potter Valley.....	600
Bolinas.....	400	Fairfield.....	1,200	^{2,6} Loma Park.....	1,325	Princeton.....	300
Boyes Springs.....	1,000	Fair Oaks.....	500	⁵ Loomis.....	500	² Red Bluff.....	3,500
Brentwood.....	500	Fall River.....	.....	Los Altos.....	1,800	^{2,6} Redding.....	5,000
Browns Valley.....	125	Mills.....	316	Los Gatos.....	4,750	² Redwood City.....	8,000
² Burlingame.....	13,150	Farmington.....	300	Los Molinos.....	460	Richmond.....	28,700
Burney.....	75	⁶ Felton.....	300	Lytton.....	100	Richvale.....	500
Butte City.....	200	Ferndale.....	1,500	Madison.....	300	Rio Del.....	600
Byron.....	400	Field's Land- ing.....	200	Magalia.....	100	Rio Nido.....	250
Calistoga.....	1,000	Finley.....	100	Manteca.....	2,000	Rio Vista.....	1,100
Camino.....	300	Florin.....	1,400	Manton.....	65	Ripon.....	1,000
² Campbell.....	1,500	Folsom City.....	1,500	² Mare Island.....	600	Riverbank.....	1,300
Camp Meeker.....	300	Forest City.....	200	⁸ Martinez.....	100	Rocklin.....	700
Cana.....	300	Forestville.....	300	² Marysville.....	8,500	^{6,7} Rodeo.....	900
⁶ Capitola.....	450	Fortuna.....	1,200	Maxwell.....	600	Rohnerville.....	300
Carlotia.....	75	French Camp.....	200	McArthur.....	167	^{1,8} Ross.....	900
Carmel.....	2,500	French Gulch.....	170	² Menlo Park.....	3,500	⁴ Sacramento.....	105,000
Carmel High- lands.....	300	Fresno.....	72,000	Meridian.....	250	Salida.....	300
Castroville.....	400	Galt.....	1,000	Middletown.....	580	³ Salinas.....	6,500
Cement.....	1,000	Gerber.....	400	² Millbrae.....	350	Sao Andreas.....	600
Centerville.....	1,775	Geyersville.....	750	Mills.....	50	² San Anselmo.....	4,500
Ceres.....	1,100	Gilroy.....	3,700	Mill Valley.....	3,500	San Ardo.....	300
² Chico.....	12,000	Glen Ellen.....	1,200	Millville.....	400	² San Bruno.....	2,175
² Chico Viejo.....	2,500	Gold Run.....	500	Milpitas.....	200	² San Carlos.....	1,300
Chualar.....	300	Gonzales.....	500	² Mission San Jose.....	500	^{2,8} San Francisco.....	708,000
Clements.....	200	Graton.....	250	Modesto.....	17,000	² San Jose.....	68,000
Cloverdale.....	1,000	² Grass Valley.....	6,000	² Modumne.....	237	² San Juan.....	500
⁵ Colfax.....	800	Greenfield.....	350	Hill.....	237	² San Leandro.....	12,000
College City.....	250	^{2,6} Gridley.....	2,500	Monterey.....	6,900	² San Lorenzo.....	1,000
Collinsville.....	300	Grimes.....	500	Monte Rio.....	500	San Lucas.....	300
² Colma.....	2,900	⁶ Groveland.....	250	⁶ Morgan Hill.....	1,200	² San Mateo.....	11,500
^{5,6} Columbia.....	400	Guerneville.....	1,200	² Mountain View.....	3,000	² San Pablo.....	1,500
² Colusa.....	2,200	⁶ Hamilton City.....	300	² Napa.....	7,000	² San Quentin.....	3,500
Concord.....	4,200	Hammonont.....	500	^{6,7} Nelson.....	50	² San Rafael.....	7,800
Copperopolis.....	300	² Hayward.....	5,000	² Nevada City.....	1,800	⁶ Santa Cruz.....	17,500
Cordelia.....	350	^{6,7} Healdsburg.....	3,400	.....	.....	⁶ Santa Rita.....	150
Corning.....	1,800	^{6,7} Hercules.....	600	.....	.....	² Santa Rosa.....	14,000
² Corte Madera.....	1,000	Hickman.....	40	.....	.....	.....	.....
² Cotati.....	600	² Hillsborough.....	1,000	.....	.....	.....	.....
Cottonwood.....	704	.....	.....	.....	.....	.....	.....

Unmarked—Electricity only.

¹—Gas only.

²—Gas and Electricity.

³—Gas, Electricity and Water.

⁴—Gas, Elect. and St. Railways

⁵—Electricity and Water.

⁶—Electricity supplied through other companies.

⁷—Gas supplied through other companies.

⁸—Water supplied through other companies.

⁹—Steam Heating.

Population. 484,314
 Total Cities
 and towns. 2,031,587
 Add Suburban
 Population. 484,314
 Total Population
 Served. 2,515,901



**Three
of the
Premier
Public Utility
Securities
of the
United States**

Pacific Gas & Electric Company

FIRST AND REFUNDING MORTGAGE BONDS

FIRST PREFERRED STOCK (6%)

COMMON STOCK (8%)

**Every One of the
NINETY THOUSAND
INVESTORS
owning bonds
or stocks of the
PACIFIC GAS AND
ELECTRIC CO.
receives
A REGULAR
INCOME
from his investment**

*are held in high regard by the investing
public because*

They are securities of one of the largest, strongest and most progressive of the nation's public service companies;

The value of the property securing these issues is substantially in excess of the entire outstanding capitalization;

The Company's business is essential in character, and is increasing steadily year by year;

These securities are always readily marketable. They are listed on Stock Exchanges in San Francisco and other financial centers.

PACIFIC GAS AND ELECTRIC COMPANY

Stock Sales Department

245 MARKET STREET

SAN FRANCISCO, CAL.

PACIFIC SERVICE MAGAZINE

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SOUTH POWER HOUSE
ON SOUTH BATTLE CREEK
IN THE MT. LASSEN TERRITORY

Vol
17

JULY 1928

No
5

PACIFIC GAS AND ELECTRIC COMPANY

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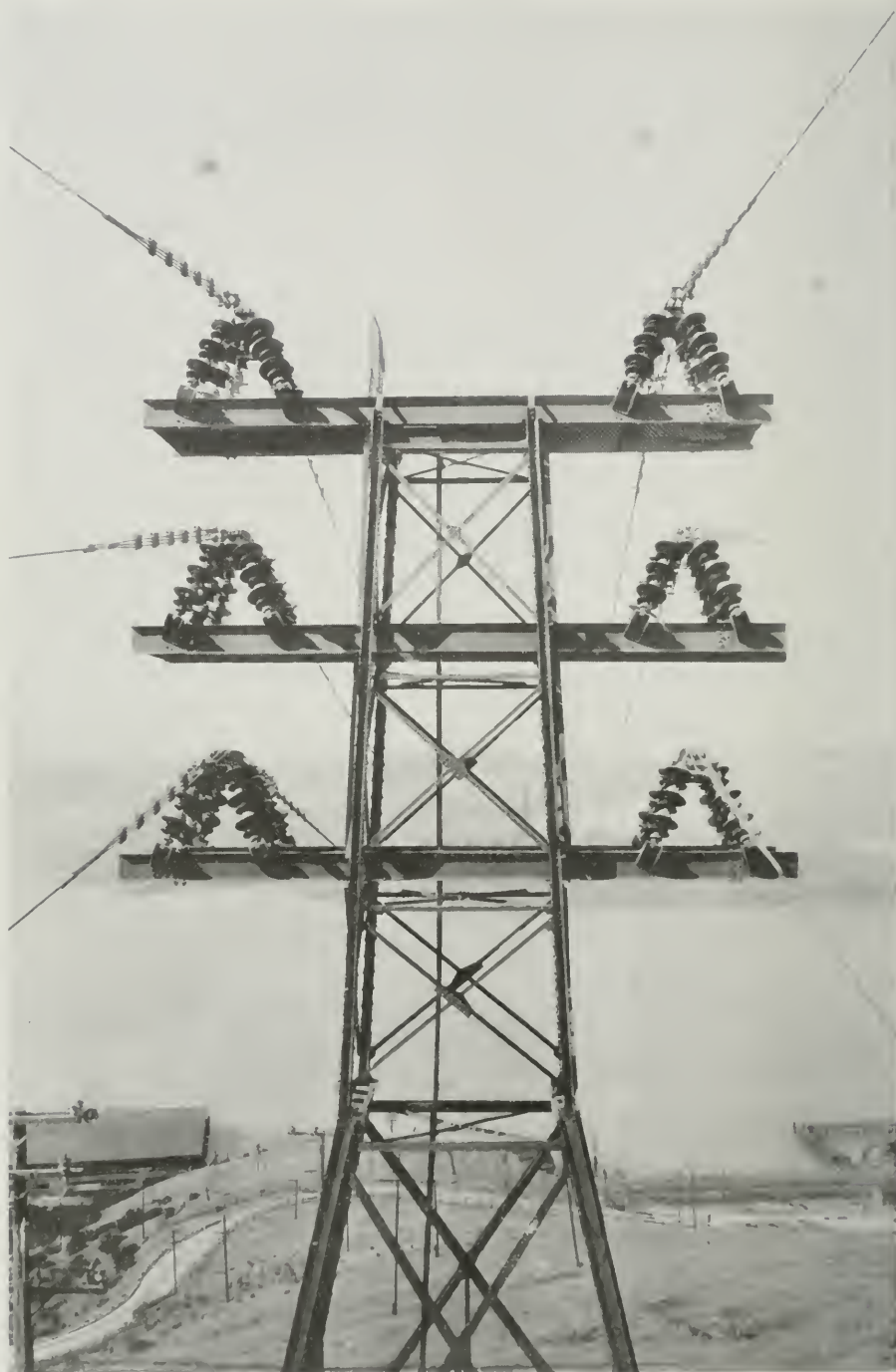
Volume XVII

Number 5

Contents for July, 1928



SOUTH TOWER, CARQUINEZ STRAITS CABLE CROSSING	<i>Frontispiece</i>
INLAND LIGHTHOUSES FOR AIR VOYAGERS— "PACIFIC SERVICE" LIGHTS 44 BEACONS	H. H. Robison 139
HIGH TOWERS ARE BUILT AND LINES STRUNG OVER MOUNTAIN, MARSH, STREAM AND VALLEY	E. H. Steele 144
50,000 H.P. TURBINE FOR OAKLAND— INSTALLATION HAS UNUSUAL FEATURES	E. A. Long 153
THE LIFE STORY OF JOHN MARTIN, PIONEER BUILDER AND DEVELOPER	F. S. M. 158
PREVENTION BETTER THAN CURE— UTILITIES SHOULD MEET ATTACK	<i>From an article by B. C. Forbes</i> 161
THE "PACIFIC SERVICE" ROLL OF HONOR	162
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 164
EDITORIAL	166



South Tower, on the Contra Costa shore, Carquinez Straits cable crossing. This structure was completed in 1915, taking the place of the original tower, erected in 1901, when hydro-electric power was first transmitted across San Francisco Bay to Oakland.
(See "Life Story of John Martin," pp 158-160)

PACIFIC SERVICE MAGAZINE

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Inland Lighthouses for Air Voyagers — “Pacific Service” Lights 44 Beacons

By H. H. ROBISON, Illumination Engineer, East Bay Division

Pacific Gas and Electric Company's engineers are busily engaged just now in carrying out a contract with the United States Government to supply electricity for the lighting of a string of forty-three powerful beacons to be stationed along the lines of air travel within the limits of our “Pacific Service” territory.

The forerunner of this contract was the establishment of an airway beacon of 10,000,000 candlepower capacity by the Standard Oil Company on the summit of Mt. Diablo, in Contra Costa county, for which “Pacific Service” supplied the electrical current. This commanding guide to air travelers by night was formally opened April 15th last. Thirteen days later the United States Government, through its Department of Commerce, 18th Lighthouse District, awarded our company an exclusive contract for similar beacon service within the territory named.

The forty-three government beacons are marked at various vantage points along the airways north, south and east of San Francisco. Along the San Francisco-Seattle route they will be fifteen in number between the metropolis and the city of Redding, in Shasta county. On the San Francisco-Salt Lake route there will be twenty-two installations between the Bay and Blue Canyon, a point in the Sierra Nevada mountains measurably near the summit and standing 4,700 feet above sea level. Along the southern route to Los Angeles the “Pacific Service” contract includes six beacons, the most southerly being at a point north of Livingston, in the San Joaquin valley.

Included in the chain are a number of emergency landing fields which will be revealed to the traveler by night through the medium of electric energy. There will be emergency fields at Capay, Williams and Willows, with beacon lighting at Woodson airport, Corning and Red Bluff airports. On the Salt Lake route field lighting will be established at Concord, Fairfield, Auburn and Blue Canyon, with a beacon light adjacent to the Roseville airport. On the



“Pacific Service” reaches to the clouds at the summit of Mt. Diablo.

southern route “Pacific Service” will establish emergency landing field light at Westley and Livermore.

The beacons will be of an average strength of 2,000,000 candlepower and will extend, in the aggregate, over 405 miles of airway. All this work is well under way. The beacon at Livermore was placed in service three weeks after the signing of the contract with the Government, and by the time this article reaches readers of PACIFIC SERVICE MAGAZINE there will be many more in commission.

Airway beacons must not be confused with the powerful illuminating installations at Mills Field and other well-known airports in our territory. They are not intended to illuminate the country around; they are intended merely as signals to the traveler to guide him on his way. They may, indeed, be termed inland lighthouses, for they will

be to the airman what lighthouses along the coast are to the mariner. But they will fill a long-felt want, for they will be the means of improving air transportation as to both direction and time schedule. For, before this new service was conceived transportation by aeroplane had been confined mostly to daylight hours. Taking, for instance, the mail air-service from San Francisco east; necessities of the time schedules cause the loss of a considerable part of the advantage which is the basic purpose of air-mail service. The business



View on the Danville road on the way to Diablo.

day ends in the evening, and the mail lies overnight in the postoffice at San Francisco until the departure of the plane in the early hours of the morning. The United States Government, therefore, undertook to provide beacon lighting which would make possible the operation of planes at any time of day or night for any desired purpose, mail, commercial or private flying. Electric energy and artificial lighting make it feasible to change flying schedules from two days and one night to two nights and one day, thus saving an entire business day for transcontinental mail.

In general the lighting of the airways comes under three classes: 1, Government lighting of beacons as a part of the lighthouse system. 2, Lighting of commercial beacons by private enterprises operating under a license from the government. 3, Flood lighting, outline lighting and obstruction lighting incidental to the use of airports at night. The Mt. Diablo beacon is an example of the second class. Concerning this the late Professor George Davidson, geologist of the University of California, was responsible for the statement that on account of the isolation of Mt. Diablo and the favorable atmospheric conditions usually prevalent there a greater area of land and water may be seen from its summit, which stands 4,400 feet above sea level, than from any other



Ten-million-candlepower beacon on Mt. Diablo, lit by "Pacific Service."

point on the earth's surface. From the summit of Mt. Diablo thirty-five counties of California, an area almost equal to the entire state of New York, are visible without the aid of a glass. During certain periods of the year high fog blankets much of the region around the mountain, but the summit rises above the fog blanket and serves as a landmark for flyers when naught else is visible. To these conditions is attributed the importance of the mountain peak in establishing a base line for the Coast and Geodetic survey as, also, its subsequent acceptance as a location for an airway beacon. Our company's line construction department undertook the work of carrying "Pacific Service" up its slopes to the summit and accomplished it in three weeks.

During the fall of 1927 and the spring of 1928 our company's engineers co-operated with those of the United States Government Lighthouse Bureau in making arrangements for the forty-three government beacons to be installed. The government's representatives did field work in selecting locations, while our company's engineers surveyed the conditions to be met in establishing service and completed the necessary work preliminary to running line extensions.

On account of the varying topography of the country in which the beacons are located, a great variety of conditions has been met in making electrical connections. In the great Sacramento and San Joaquin valleys connections were made from existing lines with but few physical obstacles. Conditions are somewhat more difficult in the foothills of the coast range. In the Sierra Nevada it has been necessary to make extensions across sparsely inhabited country at altitudes varying from 4000 to 6000 feet. Here it will be necessary to meet snow conditions in maintaining continuity of service during the winter months between October and June.

Facilities where aeroplanes land and take off, where repairs are made and commercial business transacted, are termed airports. There are three well-equipped airports and several small and intermediate landing fields in northern California. "Pacific Service" is supplied to nearly all of these locations. The San Francisco and Oakland airports have been in commercial operation for about a year and are said to be well organized. The municipal airport just north of Sacramento has recently been equipped with lighting facilities to enable flyers to land at night.



Junction of the Sacramento and San Joaquin rivers, and the Sierra Nevada range in the distance. Seen from the summit of Mt. Diablo.

The lighting of these airports is interesting. In addition to spacious ground area, level and free from ditches, trees, poles and other obstructions for landing and take-off, there must be administration buildings and hangars sufficiently large to accommodate the volume of business contemplated to be handled. The lighting of building interiors and such motor power as may be needed for shops and the operation of pumps for drainage and water supply is not out of the ordinary. The exterior of all building structures must be lighted sufficiently to bring them out in relief when observed from the air at night. The lighting of grounds and exterior structures is, therefore, special and requires special equipment and treatment in order to provide for the safe night landing and take-off of aeroplanes. This is accomplished by floodlighting units mounted on raised platforms or posts a short distance from the hangar building, or by extending the arm of the lighting fixture well above and out from the edge of the building roof and concealing the lamp under a suitable metal reflector, so that the light may be well spread upon the roof and the buildings; but the source of light must not be observable from above the building.

The border of the field, the point of approach and objects of special danger must be well defined. The border lights usually consist of low candlepower incandescent lamps mounted on short pipe supports and located 50 to 200 feet apart around the border line of the field. The border lights are white, obstruction lights are red and the approach lights are green in color.

The direction and velocity of the wind are of particular interest. This information



Ransom point, on Mt. Diablo, named in honor of the engineer who, in 1851, chose this crest as the base and meridian point from which to make government surveys of Northern California and Nevada.

is displayed by means of a windcone. Usually the windcone is made of cloth about fifteen feet long by two and one-half feet in diameter at the back end and tapering to nearly a point. This cone is supported on a high mast above the hangar or adjacent high tower. The inside of the cone is lighted by an incandescent lamp supported on the mast. The direction of the cone indicates the source of the wind and if the velocity is approximately 25 miles an hour the cone will fly nearly horizontal in position as it swings from the mast.

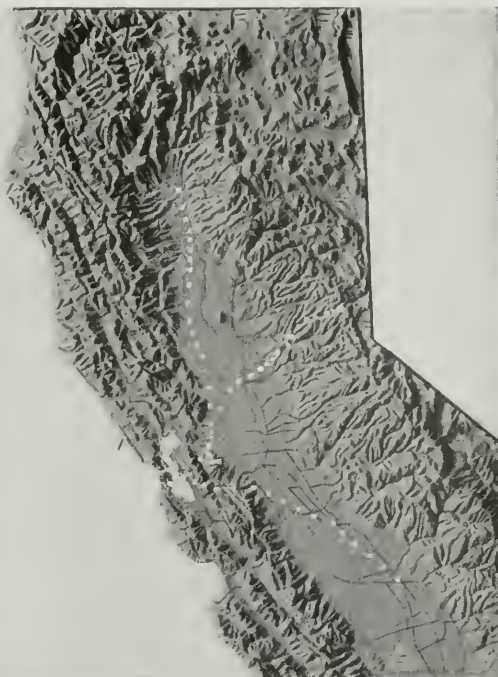
The actual location of the field at night with reference to other lighted objects of city or industrial areas is facilitated by means of a special lighting unit termed a beacon. This is an ordinary incandescent lamp of high candlepower mounted in a housing similar to a searchlight but arranged to be automatically rotated at the rate of six times per minute by means of an electric motor. The beam of this beacon is adjusted to range slightly above the horizontal and, depending upon its height above the surrounding terrain, it can be observed on a clear night from ordinary flying heights a distance 30 to 40 miles.

Landing an aeroplane at night is accomplished by illuminating the field from one or

more vantage points. This is accomplished by arc or incandescent lighting units similar to floodlights, but much larger. These lighting units are arranged to project their beams of light at reasonable intensity over a large area of the field. It is important that this field lighting shall be so arranged that the aviator is not blinded by glare when he effects a landing. Some provision must be made to protect him from the direct glare of the lamp. This is accomplished by a sharp cutoff of the light ray just a few feet above the ground level or by a "blind-strip" on the unit which is adjusted by the operator as the landing is effected. This blind-strip casts a shadow on the aviator and is adjusted by the field attendant when the landing is effected.

The lighting of the field area, all building obstructions, the windcone and the beacon are usually maintained in service throughout the night, but the lighting of the landing field by the larger floodlights is not used except when an aviator is about to land. The attention of the field attendant when airships desire to land is easily attracted by ship signals well known to ground men.

Aerial navigation promises a number of interesting developments for the near future. It is probable that a number of rail lines will engage in passenger transport. Their terminals are more conveniently located than are landing fields in the suburbs, and



Beacon-lighted air routes radiating from San Francisco bay.

the adaptation of these terminals to airport purposes is already being discussed by railroad officials. The dispersal of fogs, the improvement of lighting, increases in the number of emergency landing fields and the continued development of weather reporting and radio communication are but a few of many phases of air transport which are receiving attention.

ELECTRICAL MEN HONOR P. M. DOWNING

At the annual convention of the Pacific Coast Electrical Association, held at the Huntington Hotel, Pasadena, in June, our Mr. P. M. Downing, Vice-President in Charge of Electrical Construction and Operation, was elected President of the Association for the ensuing twelvemonth.

Other officers elected were: First Vice-President, E. B. Criddle, Southern Sierras Power Company; Second Vice-President, A. M. Frost, San Joaquin Light and Power Corporation; Treasurer, N. R. Sutherland, Pacific Gas and Electric Company; Secretary, Samuel H. Taylor.



How Towers are Built and Lines Strung over Mountain, Marsh, Stream and Valley

By E. H. STEELE, Engineer of Line Construction

Most people are aware that transmission lines form an inseparable part of electric power and lighting development. The public at large, however, has but little opportunity of knowing what goes to make up a complete transmission circuit or the amount of detail involved in its construction. On its completion it does not stand out as a structure that can be viewed in its entirety from any one point but, on the contrary, appears as a slender thread stretching across the country which when met here and there can sometimes be seen for a few hundred yards and from the most advantageous point can be seen at best for a few miles, only to disappear in the distance beyond the range of human vision.

Hydro-electric power developments have their dams, ditches, tunnels, penstocks and power-houses in the mountains, while steam-electric plants and substations are located in the centers of population. All have their fascinating and spectacular features which appeal to the visitor, some from the architectural beauty of the structures, others from their very magnitude, while each development has its own special settings and surroundings which go to make a story of almost romantic character. Then, too, attractive pictures are always available to illustrate not only the progress of the work but many of the completed developments, each of which has its individual characteristics of unusual interest. Not so with the transmission line, which stretches mile on mile across the country in more or less monotonous fashion, from the hydro-electric plant in the mountain to some distributing substation in valley, town or city. Seeing one tower or supporting structure with its in-

sulators and wire, you see what helps to make up a multiplicity of similar structures throughout the entire distance, whether the line be 10 or 200 miles long. There is, therefore, hardly sufficient inducement for the average layman, so-called, to travel the entire length of any such piece of construction unless he happens to be particularly interested in that kind of work or his duties as an employee make it necessary.

This fact, however, should be borne in mind, that the transmission lines of any given project carry a very substantial portion of the investment of any power development, that the power-house throbbing with life and energy would be dead and lifeless were the transmission line not available to absorb the energy developed at the source and transmit it to distant points where it can be turned into useful purposes, such as mechanical energy, light and heat.

The transmission line is usually regarded as the weakest link in any development chain. This is true because it is exposed to all the changing weather conditions and local menacing obstacles between the two terminals. It is always possible to have a raging storm in one section of the line with placid weather and sunshine in others at the same time. The line must be built with due



Sleeping tents of typical line camp.

regard to the changeability of atmospheric conditions and it is the duty of the designing and construction engineer to foresee as far as possible the likelihood of many contingencies and build in a manner to withstand them. The importance of this is known only when one realizes that the severance of one point in the line makes the whole useless, from power-house to substation, until the necessary repairs are made.

To insure that the work has been carried out according to plans, it is necessary to have a very careful inspection of each structure throughout the entire length of line. Otherwise, you would be depending entirely upon the care of each individual workman to carry out his individual portion of the work properly, and to depend upon this without inspection would be a dangerous procedure. A long transmission line, however, is not quickly or easily inspected in detail, as the important work to be inspected is not readily seen from the ground. So it devolves upon the inspector to climb each individual tower in order to see the details that are vital to the safety of the line for future operation have not been overlooked.

The transmission line has had to keep pace with other phases of electrical development as to design, construction and capacity. For instance, in the early history of electrical transmission to have a line 20 miles long capable of carrying 3,000 horsepower



Cook and dining tent of a Sacramento Valley camp.

of electric energy at 11,000 volts was considered a great engineering feat. Today, after less than 30 years of development work, we are able to deliver 125,000 horsepower a distance of 250 miles over a single circuit at 220,000 volts and give far better service conditions than were possible with the earlier constructed lines. Here we have over 40 times the energy carried more than 12 times the distance, with the electromotive force or pressure increased 20 times. What were considered transmission lines of high voltage in the early history of transmission of electrical power are now classed and used as distribution circuits.

It was the general practice in early transmission construction to build on public highways as far as possible. This has now been generally discontinued except in isolated cases, for three main reasons: first, the present transmission structure does not lend itself readily to highway use; second, the greater demand for highways for high-

way purposes only; third, the desire of the power company to have the shortest possible line between two common points and to keep their supporting structures from the more densely populated areas has made it necessary for a number of years past to purchase rights-of-way or easements across the properties over which the line is to cross. This entails dealing with a great many property owners for the privilege sought. It also



Interior of cook and dining tent.

involves the necessity of watching details, of preserving friendly relations with property owners during the period of construction across their property and of doing as little damage to the property owner as possible, while seeing that the damage he does suffer is adjusted fairly and promptly. It all makes for service.

Inasmuch as a modern transmission line of from 100 to 200 miles in length will require from one to two years to complete, we are bound to cross property planted to all kinds of crops, at all stages of development. This sometimes gives rise to situations more or less difficult to deal with; but fair treatment on both sides, with a mutual consideration for party rights, usually leads to a happy solution of the most vexing problems.



Removing steel forms from concrete tower footings.



Concrete crew pouring tower footings.

A transmission line must invariably cross many miles of mountainous country before the valleys are reached, and in such sections, particularly, areas of very considerable extent are crossed that are devoid of roads and very difficult of access. In such cases a certain amount of road building has to be done, but owing to the extremely small tonnage to be handled to any given point a considerable amount of judgment must be exercised in deciding the amount of road building to be undertaken, with consideration given to the desirability of finding some other means of transporting the material. As a rule, however, some kind of road or trail has to be constructed to these isolated sections of the line.

For the care of workmen during construction, highly portable camps must be maintained, camps that can be quickly and easily moved and, at the same time, afford the men a maximum amount of comfort and convenience. With the Pacific Gas and Electric Company, a standard camp of this character is designed to house 60 men. The kitchen tent, standard design of which is a combination kitchen and dining room, measures 24 by 40 feet, with 6-foot walls, having an adjoining tent for commissary use with dimensions 16 by 18 feet. The foreman and timekeeper use a tent 12 by 14 feet in measurement. The kitchen help occupy 2 tents, 12 by 14 feet each, and the rank and file of the crew are furnished 16 by 18 foot tents, allotting 5 to a tent. Each tent is supplied with a small airtight heater, and the lower edges of the walls are held in place by the use of 12-inch baseboards which are hinged and bolted together. This avoids the neces-

sity of bringing the tent walls to the ground line, insures greater life to the tent and, also, permits the keeping of the tented area dry and warm.

Even though line construction camps must be of a portable type to handle the work in an economical manner, they also must be erected and maintained in a way to keep men fit for a job which must be carried on in all kinds of weather and often under very trying conditions. Men must be fed with plenty of good, wholesome, well-cooked food. Camps are not, as a rule, located where water, ice or food can be readily obtained, but are scattered along a line usually away from the main traveled roads in the mountains or out in the valleys. Thus, it takes much planning and care to get perishable foods, such as fruit, vegetables, meat and eggs, transported to the job and to keep them in good condition without refrigeration.

Water is always a line construction problem, sometimes due to the lack of it for camp use and concreting during the summer months in the foothills and in the val-



Concrete pier for the support of one corner of a transmission tower.

leys; oftentimes because of its abundance, as when the line passes through irrigated fields or skirts the San Francisco Bay. In the first instance, tank trucks and wagons are employed to bring the water from the closest source, but the second case is more difficult, in that the water is neither good for drinking nor concreting.

An example may help to show the trying conditions that come up on this type of construction. An important line is nearing completion, the plans are made and the date set for bringing a new block of power over it into the company's system. Heavy copper wire must be laid out and then placed on towers which are located through long stretches of rice fields. It is impossible to use trucks or even horses on such flooded, soft ground, and also impossible to wait until the season for draining these areas. Men, therefore, must wade in mud up to their knees and water up to their waists, carrying materials and pulling wire to complete the line.

A general camp view in this article will give some idea of the arrangement of a standard line camp. Usually not more than 60 men are maintained at any one camp location. All camp equipment is interchangeable in character. Camps are placed at distances from each other ranging from 3 to 10 miles, depending on the character



Building 100-foot towers in Sacramento Valley.

of the country to be covered, the available water supply, etc. The number of camps to be maintained depends largely on the length of the line and the number of men it is decided to keep employed at any one time.

In the case of tower-line work, one camp is usually maintained on each class of work from the start to the completion of the line. This makes the men highly specialized and proficient in their respective duties, the several crews following in the order of the work to be accomplished: first, clearing rights-of-way of brush and trees, building roads and trails; second, hauling and distribution of material; third, excavation crew; fourth, foundation crew; fifth, tower-building crew; sixth, wire-stringing crew. By this arrangement, if the crews are kept properly balanced, each class of work and each crew can progressively advance, reducing the moving of men and camp equipment to a minimum and, at the same time, producing a sufficient amount of rivalry among the foremen to stimulate efficiency.

About two or three more camps should be available than are actually in use, so as to permit a skilled camp erection crew to have a camp erected and ready for occupancy for the advance crew to move into without entailment of confusion in any of the crews that follow. The last camp being abandoned and left for the camp-erecting crew to tear down and move ahead for future occupancy of the advance crew.

If the actual start of construction work on transmission lines can be delayed until the surveys and purchase of rights-of-way have sufficiently advanced to permit unobstructed progress, very large savings can be made. To have the construction crew too



Completed tower supporting one transmission circuit.

close on the heels of the right-of-way work interferes very decidedly with the intelligent planning of a construction program, slows down the individual workman through fear of being laid off and tends generally to bringing about unsatisfactory and inefficient results. The cost of changing plans falls on

the construction organization and in a manner that cannot be clearly and concisely explained. Care and thought, therefore, should be used to avoid this condition in the construction of transmission lines.

In the network of transmission lines which cover our "Pacific Service" territory there are many quite spectacular in character, which even to the untrained onlooker give some idea of the physical difficulties the line crews must



Placing tower foundation for line crossing tide lands of San Francisco Bay. Board walk for construction and maintenance of line.

have encountered in meeting topographical problems of an unusual variety. It may be said that all of the many and varied problems of whatever kind were met and overcome. Taking by way of illustration some of the more important of these, we begin with the Drum tower line. Construction on this was started in the early fall

of 1912 and the line was completed and put in operation November, 1913. It is 110 miles in length. Its beginning is in the heart of the Sierra Nevada mountains



Special high tower construction for slough crossing, showing boat house for men and construction equipment.

(Drum Power House) at an elevation of approximately 3500 feet above sea level and ending at Cordelia Substation at practically sea level. In its course it passes over a summit 4200 feet in elevation, covering 40 miles of rough, mountainous country with deep canyons requiring single spans of from 2,000 to over 4,000 feet between supporting structures.

When the valley was reached it would appear that there was nothing of an unusual character to interfere with the normal progress of the work, but it must be remembered that at the time this line was built our fine roads and concrete highways were not in existence and gas-driven transportation was very much of a luxury. All transportation, therefore, had to be handled by slow-drawn horse vehicles. In the mountainous section many roads and trails had to be provided for the transportation of material, and in providing roads we had occasion to uncover a number of the old immigrant trails of the early-day gold seekers. Many of these had so completely disappeared under a growth of underbrush that one would never have suspected that a particular brushy hillside only a few years before had been teeming with the life of the California fortune hunters.

All tower supports were provided with concrete foundations. In order to complete on time it was necessary that the plans provide for the starting of the work at the Drum Power House end of the line with a view to getting out of the high mountains with that portion of the work involving



Distribution line through virgin forest.

clearing of rights-of-way and placing of foundations before being overtaken by the rigorous storms of winter. As it was, before the construction crews had reached the lower mountain elevations, four feet of snow overtook them; however, the delay was not serious, as wheeled rigs were soon converted to bob-sleds and the work continued on schedule.

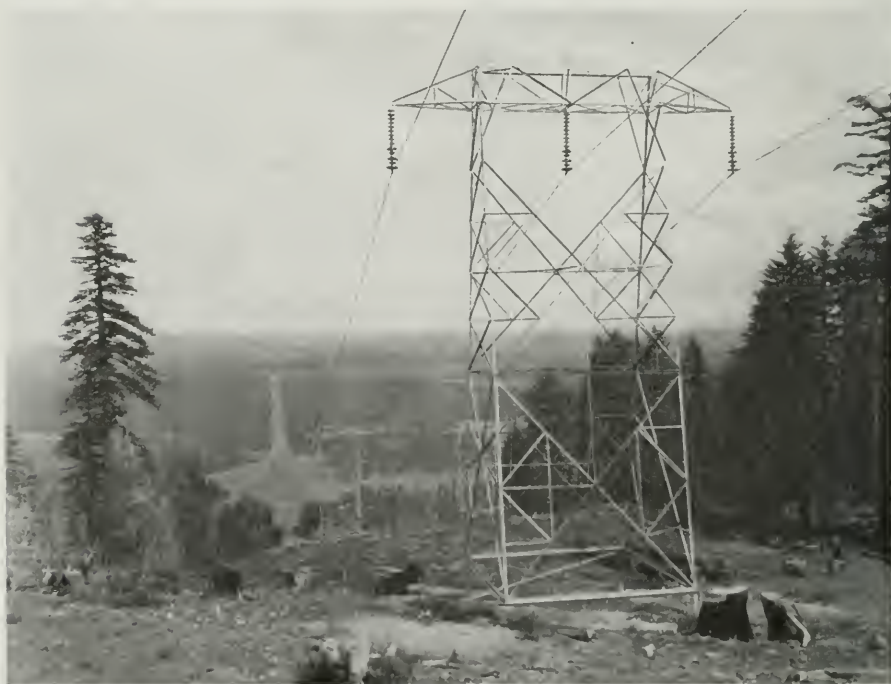
On reaching the valley our operations continued for a number of miles under most favorable conditions, but we soon reached the north bank of the Feather River; and we were not at that time blessed with the many levees that now hold the turbulent tributaries of the Sacramento River in their proper confines; nor were there bridges to make easy passage from the east to the west side of the valley. The Drum line crosses the delta lands just above the point of confluence of the Sacramento and Feather Rivers, and these lands at the time of its construction were unreclaimed territory. The distance across this delta section was a little



Winter scene of camp in Pit River country.

over seven miles and was continuously under from 5 to 20 feet of water from the early part of November of each year until the following August; our work, therefore, had to be carefully planned to complete this section of line during the three dry months of the year, namely, August, September and October, or lose an entire year's work before the completion of the line.

Work being completed to the north bank



In the mountains. Pit transmission lines looking into Burney Valley.

of the Feather River, it was found necessary to transport the entire organization to the Cordelia end of the line, with the view of completing all work south of the south bank of the Sacramento River in time to take up work on the overflow delta lands during the dry season. There was no direct means of crossing the flooded areas to reach the southern end of the line, only two practical routes being available; one, by traveling north along the river bank for nearly 50 miles to where a crossing could be made at or near Colusa, then traveling south for more than 125 miles to the point where our work was again to be taken up; the other was to charter a river steamer traveling down the river for a distance of approximately 140 miles to the town of Rio Vista, thence a 25-mile overland trip to the point of beginning. The latter route was chosen. Camp broke, we were on our way with 160 head of work horses, wagons, camp equipment and construction equipment for the care and service of a crew of this character. This move was made, camp set up and again ready for operation on the fourth day from breaking camp on the previous location. Our construction north proceeded as planned and we reached the south bank of the Sacramento River the early part of August. The water had receded from the seven miles of delta lands between the two rivers and work was pushed on north until the gap was closed at the Feather River crossing.

Another line was in progress of construction at the same time as the Drum line, that from the Cordelia substation to the Marin substation, known as our Cordelia-Marine line. It is in reality an extension of the Drum line, a little more than 50 miles in length, and for more than 75 per cent of the distance skirts the north shore tide lands of San Pablo Bay and other arms of San Francisco Bay until it reaches the Marin substation at Sausalito on the shore of the Golden Gate. A great deal of the line as located was at this time subjected to overflow during each high tide. The tide lands were of a soft mud formation, so deep that solid bottom for foundations could not be reached. Piles had to be driven to a depth of 55 feet, relying entirely on the skin friction of the piling in the mud to support the required weight of towers. These piles were driven to a point below low water mark, capped with concrete to support the towers.



The 410-foot tower on the north bank of the Sacramento River.

Along this route nine navigable streams had to be crossed, requiring towers ranging from 176 to 248 feet in height to meet Government requirements of maintaining a minimum clearance of 125 feet above high-water mark from the lowest wire. To carry out this construction the workmen had to be housed on floating equipment; barges had to be used for transporting material and for working space for the men during construction.

The Pit River transmission line, of course, is of more recent construction, having been started in 1921, when good roads were the rule in many sections of the country, present modern transportation available and much modern equipment designed to meet construction of this character. However, the line still had its problems and isolated sections which required more than ordinary consideration. This line has its beginning at Pit No. 1 and Pit No. 3 power-houses, running thence to the lower end of the Sacra-

mento Valley at Vaca-Dixon substation, with its extension into Contra Costa County to what is known as the Contra Costa substation. It covers a total distance of 247 miles and has several unique features aside from the fact that it is one of the pioneer 220,000-volt lines.

While the Pit River drains into the Sacramento, having cut a deep gorge through the Sierra Nevada range, nevertheless the Pit power-houses are in reality on the Nevada side of the Sierra Nevada mountains. So, in order to reach the upper end of the Sacramento Valley, 70 miles of mountainous region had to be crossed, the highest elevation being about 4,850 feet, on Burney Mountain. Of this distance, a stretch of 35 miles lay through virgin yellow and sugar pine forests, which required the cutting of millions of feet of timber to guarantee a clearing that would properly safeguard the operation of a line of this character.

The valley construction was comparatively simple except where rice fields were encountered, and of these we had some five miles to cross. Here the land is kept under from 6 to 12 inches of water during the rice-growing period, which extends from May 1st to the middle of October. Unfortunately it is not practicable for our line construction gangs to select their own season of the year for crossing any particular territory and so they have to make the best of such situations as they encounter. In this instance, men had to carry most of the material in by hand, stripped of most of their clothing, as the humidity in a rice-growing field in the middle of summer is almost unbearable.

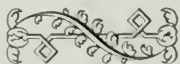
Our next special problem to be attacked on this line was the crossing made near the confluence of the Sacramento and San Joaquin Rivers. Here the lowlands which are protected by levees are several feet below sea level. Pile foundations ranging in depth from 60 to 80 feet had to be provided, which were capped with massive concrete foundations from which rose towers ranging from 230 to 460 feet in height. These were

the supporting structures for crossing the two important drainage streams of the big valleys of California; that across the Sacramento having an individual span between the nearest supports of 4,135 feet and a total span of 8,030 feet from anchorage to anchorage. In the case of the San Joaquin River, the longest individual span between supports was 3,175 feet, but having a total distance between anchors of 9,840 feet. These crossings had to be made with a continuous piece of cable from anchorage to anchorage, without splices.

These crossings are distinguished by some of the highest, if not the highest, transmission towers in the world, and embody many unique features in design and construction. Special equipment had to be provided to carry out the work, all of which has been quite completely described in a previous issue of PACIFIC SERVICE MAGAZINE.

The Carquinez Straits crossing is too well known to require any special mention here, other than to say that it has stood for 25 years without a single failure as a monument to the pioneering enterprise of those men who were responsible for the design and execution of the work, to say nothing of those who were willing to furnish the necessary finances to make a long-distance transmission line a reality when to the world at large it was viewed as a myth, as something too visionary to bring about substantial results. It took courage and confidence to accomplish things under those conditions.

Other lines of "Pacific Service," such as the Oakland-Newark, Newark-Martin tower lines, skirt the shores of San Francisco Bay for more than 80 miles, and travel through country most difficult to work in. In the various tide lands crossed by these tower lines more than twenty-five miles of permanent board walks had to be constructed at elevations above high tide limits of the most extreme conditions for the use of workmen during construction. These walks are now in regular use by patrolmen in their work of inspection and maintenance.



50,000 H. P. Turbine for Oakland— Installation Has Unusual Features

By E. A. LONG, Assistant Engineer, Bureau of Specifications and Estimates

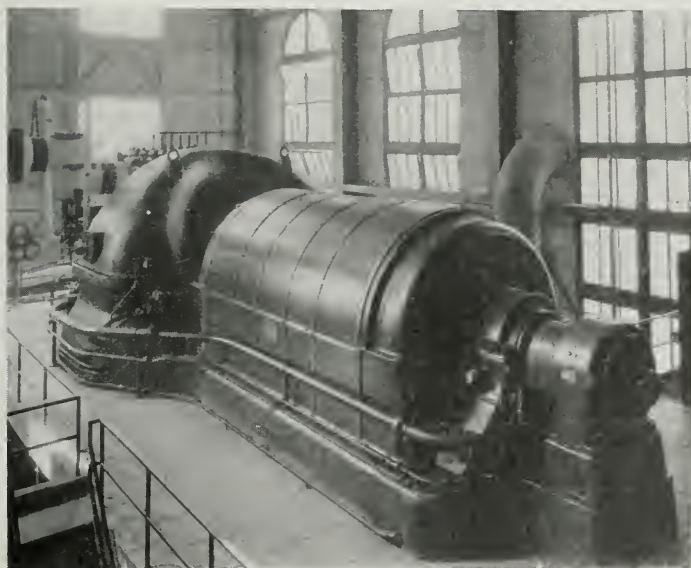
As a result of the rapid development of the East Bay territory in and around the city of Oakland our company is installing at its Station "C," Oakland, a 50,000 horsepower steam-electric turbine, together with boilers of the latest design and the necessary auxiliary equipment. This will be the largest steam-electric unit in the "Pacific Service" system.

The installation presents some rather unusual features. The turbo-generator has a rated capacity of 37,500 kilowatts, which is the equivalent of 50,000 horsepower, although it will carry a load of 42,000 kilowatts or 56,000 horsepower. In order to get a machine of this capacity in the available space, it was necessary to develop a unit of special design. The usual impulse turbine of this capacity has 17 or more stages, that is, 17 separate impulse bucket wheels mounted on the one shaft, but such

a machine would have been far too long to fit into the space available at Station "C." The 9-stage unit which was finally selected as being the most advantageous is believed to be by far the largest 9-stage unit ever built.

Another interesting feature of the turbine is the fact that it has been designed to give exceptionally good efficiencies, at light loads, since it is expected that it will be run as a standby unit during the greater part of the time, which means that it will carry very light loads. As is usual in modern turbines of this type, the efficiency is greatly improved by extracting or "bleeding" steam from the turbine to heat the boiler feed water. The steam which is extracted at four points on the turbine heats the feed water to 375 degrees Fahrenheit, which is well above the boiling temperature of water. This feed water is in reality the exhaust

steam from the turbine which has been condensed in the condenser to create the necessary vacuum in the exhaust and then returned to the boiler through the extraction heaters as boiler feed water. In this way, since the steam which enters the feed water heaters is finally condensed and introduced into the feed water pipes, the water is completely recirculated, it being necessary to add only small amounts of



New 50,000 h.p. steam-electric turbo-generator in place at Station "C," Oakland.

make-up water from time to time.

Great care has been taken, however, to insure that the water which is added to the system is entirely free from the various injurious salts which deposit boiler scale in the boiler tubes and impair their life as well as the efficiency of the boiler. To this end there have been installed a water softener and evaporators which remove the injurious ingredients.

The condenser, which is of the horizontal tubular type, makes use of salt water from the estuary for cooling purposes and for this reason the tubes are made of the Admiralty mixture, a metal designed to withstand the action of salt water. Some idea of the size of the condenser may be gained from the fact that at full capacity water must be pumped through it at the rate of 60,000 gallons per minute, the intake and outlet pipes being 6 feet in diameter. It is interesting to note that if this water were fresh and fit for domestic consumption it would be an adequate supply for a city of more than 100,000 inhabitants.

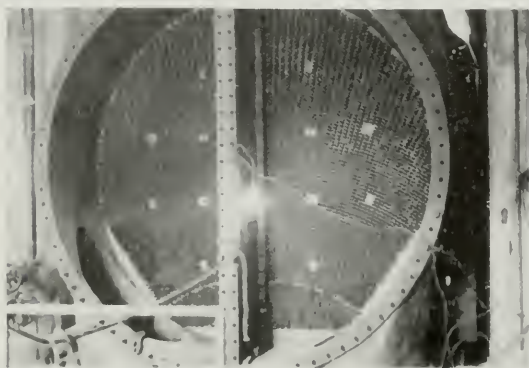
The vacuum created by the condenser is equivalent to about 14 pounds per square inch at the turbine exhaust. This increases the pressure drop through the turbine and greatly increases its capacity and efficiency.

To supply steam for the new turbine, eight old boilers have been torn out and two large boilers with auxiliaries are being installed. These boilers, which are the largest



Another view of the turbine, showing substantial foundation.

built to date, are of such a capacity that either will supply steam enough to run the turbine at full load, the extra one being provided as a spare. Some idea of the enormous size of the boilers may be obtained from the fact that they reach to the height of a five-story building, an automatic elevator being provided to furnish transportation to their various elevations and to their auxiliaries. They will operate at a pressure of 450 pounds per square inch, while super-heaters which are being installed will heat the steam to a temperature of 730 degrees Fahrenheit just before it enters the turbine.



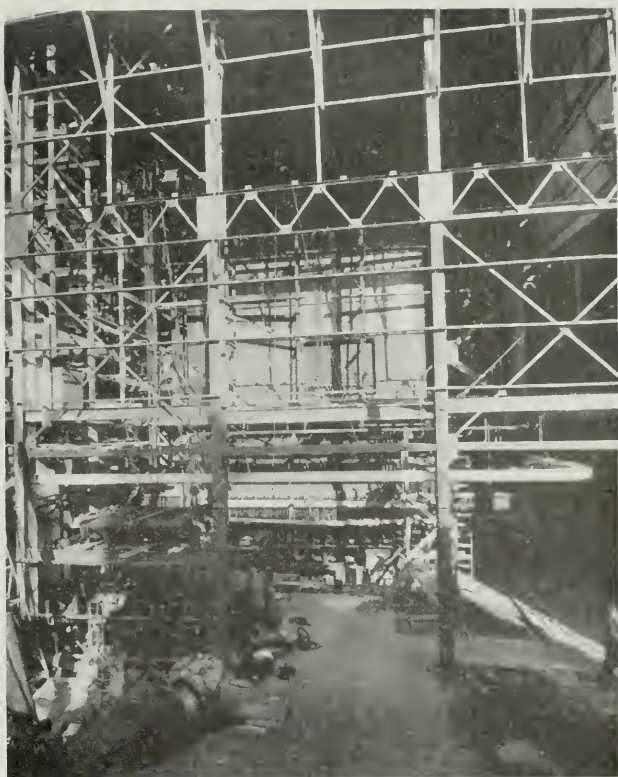
New condenser, with head removed, showing Admiralty mixture tubes.

The excessive temperature at which the furnace must operate at full load has rendered the use of solid brick furnace walls almost impossible. To provide walls which can stand temperatures as high as 2900 degrees Fahrenheit, which is expected to be a maximum in the furnace, and also to assist in extracting all possible heat from the flame, water-cooled walls are used.

The walls consist of cast-iron blocks faced on the inside with a refractory lining which will stand the high temperatures of the furnace. The water-cooling feature consists of vertical tubes $3\frac{1}{4}$ inches in diameter, spaced 6 inches apart measured from center to center of the tubes. These tubes fit into the outer sides of the cast-iron blocks. Thus the heat from the furnace is carried directly to the water in the tubes and through them to the main boiler, since the tubes are connected to the main boiler through suitable headers.

Another late development which has been incorporated into the furnace is an air preheater located in the flue above the boiler. By means of this the hot flue gas, which normally would escape from the plant bearing a large amount of heat, is divested of a considerable portion of it which is used to heat the air needed in the furnace for proper combustion. It can readily be seen that heating the great amount of air needed by the furnace from 80 degrees to 498 degrees and reducing the temperature of the stack gas from 700 degrees to 353 degrees will materially improve the over-all efficiency of the plant.

The draft in the furnace will be artificial, that is, a fan will be placed in the stack to draw the flue gas from the furnace and force it up the stack, while another fan will be placed in the line of incoming air to draw it through the preheater and force it into the furnace. The fans have been generously designed, because the time necessary to increase the turbo-generator output from standby to full load is determined largely by their ability to draw heated air into the combustion chamber. The induced draft fan on each boiler has a capacity of 160,000 cubic feet per minute, while the forced draft fan has a capacity of 125,000 cubic feet per minute.



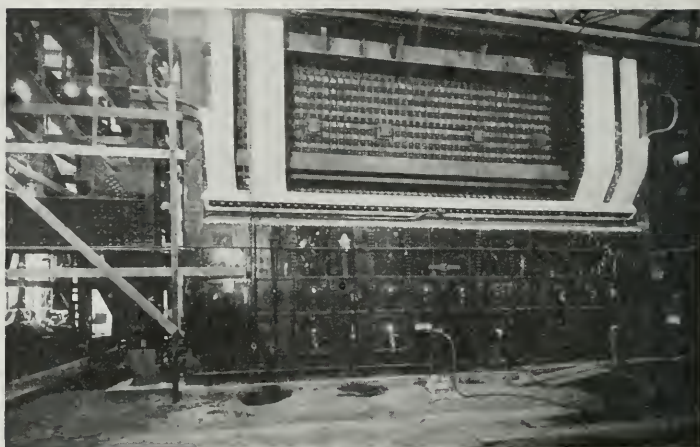
One of the new boilers in process of installation.

Ordinarily these fans would be equipped with variable speed motors to make it possible to reduce the flow of air at low load periods, since too much air in the furnace is as undesirable as not enough. Each fan, however, has been equipped with two constant speed motors, one on each end of the fan shaft. One of these motors is large enough to drive the fan at maximum load, while the other is of a lower speed and only large enough to drive it under the more common standby conditions.

Another point of interest is that each fan is equipped with variable vanes, a very recent development in fan engineering, which can be adjusted to regulate the output. In this way the necessary gradation of output can be obtained while using the more efficient constant speed motors. The effect of having one idle motor which must be rotated at all times is negligible compared to the losses which would be incurred were variable speed motors used. It is interesting

to note that the fans installed at this plant are among the largest built to date for this type of service.

Perhaps the most unusual feature of the entire plant is the equipment for the automatic control of the boiler and the system of indicating meters which is closely allied with it. Equipment has been used for many years on hydraulic and steam turbines which automatically causes them to deliver more or less power into a transmission line as this power is demanded by consumers, the actuating impulse coming from a minute decrease or increase in the frequency or rate of change of direction of the alternating current on the line. Its operation on a steam turbine, however, presupposes a constant steam pressure in the

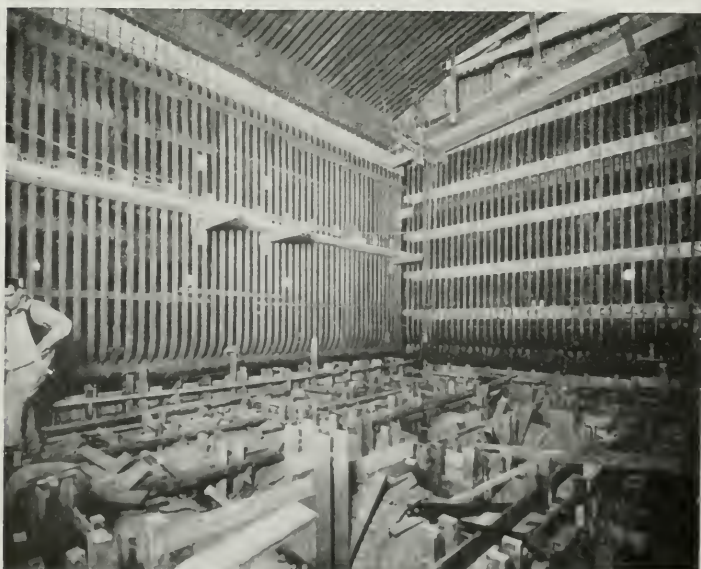


Front view of lower part of new boiler, showing battery of oil burners.

boiler and this has always been dependent on human operators who increase or decrease the fuel oil supply and regulate the draft in order to keep it as steady as possible. In Station "C" the steam pressure is maintained at a constant value by means of automatic control equipment. This keeps the pressure more nearly constant, due to its sensitiveness, and at the same time makes

the system more flexible and thus more effective in quickly picking up a suddenly applied load.

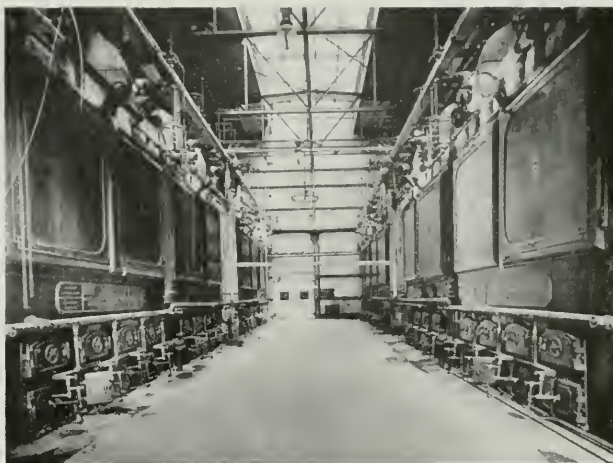
What might be called the foundations of this system of control are the various measuring instruments which indicate on recording dials, centrally located on the main floor of the boiler room, the various temperatures and pressures which it is necessary to know in the operation of the plant. On the recording dials there is a continuous record of the



Interior of the furnace. On the sides are the water-cooled walls prior to setting of cast-iron face brick. Below are the air-ducts to the furnace, while at the top are the main boiler tubes.

flow of steam from the boiler, the flow of air through the fire box, the pressure and temperature of steam leaving the superheater on its way to the turbine, the furnace draft, windbox pressure, fuel oil pressure and the temperatures of flue gas leaving the boiler, leaving the air preheater and in the windbox. Of these the most critical data are the relationship of the flow of steam to the flow of air and the pressure and temperature of superheated steam, all of which should remain practically constant. For this reason the control of the boiler is actuated by the equipment which records these values.

The actual construction work on the station was rendered more difficult than usual on account of the existing equipment. It was not only necessary to exercise the utmost care, so as not to damage it, but it was also necessary to keep the boilers and turbines which were to be left in the station in condition to operate at any time during the construction period. Careful planning has made it possible to accomplish this. The work has been brought to such a stage at the present time that it is expected that the latter part of August will see the new equipment in regular operation, safeguard-



Eight old-style boilers were removed to make room for new boiler installation.

ing the "Pacific Service" network in and around the city of Oakland.

This East Bay territory, the development of which necessitated this installation, has of late been enjoying a most phenomenal growth. In the eight years since 1920 the connected load on the company's lines in East Bay Division has grown from 135,000 kilowatts to more than 302,000 kilowatts, an increase of 124 per cent for the period, which is equivalent to a growth of $10\frac{1}{2}$ per cent a year, compounded annually. At this rate of increase the load would double itself every seven years.



The Life Story of John Martin, Pioneer Builder and Developer

On May 23rd last, in San Francisco, died John Martin, pioneer builder and developer, universally recognized as the man above all men responsible for the establishment of hydro-electric power in California as an assured factor of progress and development throughout the State.

For, it was through the genius of John Martin, backed by his indomitable energy and resourcefulness, that the long distance transmission of hydro-electric energy at high voltage was first successfully carried out, resulting not only in the carrying of the precious "juice" from the water-power plants in the mountains to the centers of industry on and around San Francisco bay but, also, in the utilization of this energy on its way across country for the benefit and development of agriculture.

The story of John Martin is the story of one who had the vision to plan ahead of his time, the determination to succeed, the personality to inspire confidence in those he sought to interest, the ability to organize, until one by one the enterprises he initiated grew until they spread a network of public service over the entire north central section of California.

Of Alsatian stock, John Martin first saw the light of day in Indianapolis, in 1858. His parents died when he was very young, and he was removed to Brooklyn, where he remained for a while under the care of an aunt. When only thirteen years of age, however, he decided to strike out for himself, and it is said that he began his career as a newsboy on the streets of Brooklyn. As he grew to manhood he became interested in other matters, and he pursued various occupations. He went to Alabama and there he married and raised a family. He was for

a time engaged in real estate development, but the bottom fell out of what had promised to be a successful venture and he was forced to take up a new line of activity. He was of a mechanical turn of mind and he

became interested in machinery. He went to Chicago and took service with the Armours, among other things installing a refrigerator plant for them. In 1891 he came with his family to California and engaged in the coal business with a well-known San Francisco firm. Then he struck out for himself and established the firm of John Martin & Company, dealers in pig iron. He became agent in San Francisco for the U. S. Cast Iron Pipe Company, his largest customer being the Spring Valley Water Company.

But it is with his entrance into the public utility field as organizer



The late John Martin.

and developer that the really interesting chapter of John Martin's history opens. In 1894 he became acquainted with one Charles C. Lindner, who had come to the coast to install some machinery for the street railroad system in San Francisco. Lindner held a letter from the Stanley Electric Manufacturing Company, of Pittsburgh, authorizing him to sell electric machinery on commission. Martin and Lindner became associated, and in December, 1894, Martin went East and secured the exclusive selling agency on the Pacific Coast for the Stanley Company's alternating current generating apparatus and transformers. He had, in the meantime, become acquainted with Eugene de Sabla, Jr., who two years previously had made the first installment of electric power for mine operation at Bodie, California, and encouraged by its success was contemplating construction of a hydro-electric plant on the South Yuba

river, six miles above Nevada City, to supply electric power to the mines of that region as, also, to the municipalities of Grass Valley and Nevada City. The result of this association was the completion of the South Yuba plant, for which the Stanley Electric Company, through John Martin, supplied the machinery.

In 1897 John Martin became interested in the disposal of a gold mine at Brown's Valley, some twelve miles north of Marysville. The mine was operated by steam power, wood being used as fuel, and when Martin looked it over it occurred to him that the mine might be more successfully operated by water power from the Brown's Valley ditch, which was fed by water from the north fork of the Yuba river. He conceived the idea of a power plant operated by water from the ditch, and the use of that same

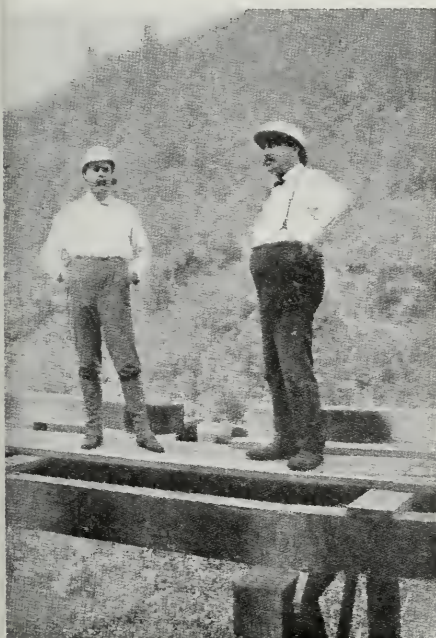


John Martin on the porch of Yuba power-house.

water for irrigation purposes. From this sprang into existence the Brown's Valley power plant, with an installation of less than 1,000 horsepower, but which carried the precious energy into Marysville for lighting of the city streets and residences and the operation of a big mill owned by the Sperry Flour Company.

It was, in fact, a contract with the Sperry Company that made this Brown's Valley plant possible. Hydro-electric development was not easy to finance in those days and Martin had his troubles, but he interested people with his optimism as well as his honesty of purpose, with the result that while the Stanley Company installed the machinery for his power project, a local lumberman supplied the poles and an Eastern concern furnished the aluminum wire for the transmission. Power was delivered to Marysville in March, 1898, within eight months from the time when construction work started.

After that John Martin began to launch out. The Folsom power plant, on the American river, pioneer of them all, ran short of water in the dry winter of 1897-98, and the Sacramento Electric, Gas and Railway Company stood in need of additional service. John Martin, Eugene de Sabla and R. R. Colgate, the latter a New York engineer who had become interested in the Nevada plant, got together and on the strength of a contract with the Sacramento Electric, Gas and Railway Company constructed the Colgate power house, on the North Yuba river. From that plant power was first transmitted



R. R. Colgate and John Martin on the Colgate flume.

into Sacramento, sixty miles distance, at 34,000 volts, and in 1901, the year following the completion of the Colgate plant, power was delivered into Oakland at 60,000 volts. *This was at that time the highest voltage of any commercial transmission line in the United States and was the forerunner of all future high-tension development.* This transmission accomplishment included the crossing of San Francisco bay at Carquinez straits by overhead cable, in a span of 4,427 feet between towers, which for upward of twenty years held the record.

In the meantime John Martin had also gone into the gas business. He had established a plant in Marysville, despite the opposition of the then existing plant, and in a very little while controlled the public service there. The rest of the story is well known to readers of PACIFIC SERVICE MAGAZINE. Early enterprises grew and combined. The Nevada Electric Power Company and the Yuba Power Company consolidated under the corporate name of the Bay Counties Power Company. The Bay Counties Power Company acquired the Standard Electric Company, with its plant on the Mokelumne river, and then sprang into existence the Valley Counties Power Company, which acquired the Centerville plant on Butte creek, near Chico, and then developed the de Sabla plant higher upstream. In the course of time more combinations were effected, and in 1903 the Bay Counties Power Company, Valley Counties Power Company, Oakland Gas, Light and Heat Company, Sacramento Electric, Gas and Railway Company and the California Central Gas and Electric Company came together in a consolidation known as the California Gas and Electric Corporation, the immediate predecessor of Pacific Gas and Electric Company.

In all these enterprises John Martin was a leader. He never sought great distinction for himself, though he served for a while as vice-president of the California Gas and Electric Corporation and afterwards held a similar position with what is now "Pacific Service."

He was a pioneer of rural electrification. In 1898 he persuaded J. P. Onstott, a farmer living near Yuba City, to take out his gas engine and install an electric motor. Speaking of this accomplishment in after years the late Mr. Wiggington E. Creed, our company's president, said:

"Mr. Martin, like most men with dreams,

was ahead of his time, a pioneer. Power men of that day were not with him. They thought the great cost of delivering electric energy to isolated farms would be prohibitive; moreover, their eyes were on the business of cities, where consumers were closely congregated. Even farmers themselves thought electric power was too new and too uncertain to be relied upon to drive pumps or even to furnish light. It took considerable salesmanship to install the first motor. The company had to extend its line to the farmer's house at its own expense. It had to lend the farmer the motor, with the understanding that he would pay for it only if it proved satisfactory."

This initial experiment turned out a decided success, however, and today there is an amount of 239,732 horsepower in agricultural motors depending upon Pacific Gas and Electric Company's service alone.

He had other interests. In 1902 he became president of the North Shore Railroad, now Northwestern Pacific, and through him the road was broad-gauged and electrified. He founded the Midway Gas Company and the Santa Cruz Beach Company. He also purchased a controlling interest in the South Eureka Mining Company, in Amador county.

In the years following the San Francisco disaster in 1906, John Martin suffered reverses of fortune which for a time threatened to sap his energies, but he rose superior to his troubles and to the day of his death was always active and optimistic, always planning for the future. It has been said that had he lived he would have pulled out of his financial tangle in a very few years and been once more independent. His last venture was in the Mid-Continent Utilities Corporation, controlling and operating public utilities throughout the Middle West from Illinois to Alabama. When he died he was executive head of that concern.

Perhaps the proudest moment of his life was when he received a communication from the State Librarian at Sacramento informing him that he had been enrolled as one of California's forty foremost pioneers of industry.

He was a man of great vision. He had unbounded faith in the future of the country in which he lived and in his own ability to assist its progress and development. He never lost heart. In his personality alone he afforded an example for the younger men of this generation to follow. —F. S. M.

Prevention Better Than Cure— Utilities Should Meet Attack

(Excerpt from article by B. C. FORBES, in Forbes Magazine)

... "For some time the 'Power Trust' investigation has been waged with extreme aggressiveness by the Federal Trade Commission on imperative instructions from Congress. The newspapers have followed the developments quite closely. Some of them have professed to be horrified at the existence of a 'lobby' in Washington and at the activities energetically carried on by the National Electric Light Association and other organizations with a view to giving the public a fuller and more favorable understanding of the utility industry.

"Why, in the name of common sense, should not every business man in America—every citizen, for that matter—favor the exercise of the utmost vigilance to prevent the passage of inimical legislation? Prevention is better than cure. Surely, it is logical to seek by every legitimate means to prevent the passage of unfair, unjust, unwise laws rather than to sit back supinely and let politicians misrepresent and distort things to their heart's content.

"Enlightened business and financial leaders and intelligently managed organizations and associations of business men have played a foremost and, on the whole, a most laudable part in disseminating education on the A-B-C's of economics.

"In the old days many public utilities had a bad name because they deserved a bad name. Proverbially, a bad name sticks. The modern generation of utility men were, therefore, confronted with the problem of convincing the people that the bad old methods of conducting business had been discarded and that the average utility organization of today is conducted honestly, honorably and ethically.

"In their zeal to carry out this not-easy task an employee here and there, the investigation has revealed, went too far. Knowing the utility men as I do, I am convinced that their occasional errors of judgment in furthering their educational activities were inspired by their consuming belief and enthusiasm in the worthiness of the cause rather than by any base motives.

"Much has been made of certain indiscreet political contributions, but how many business executives or corporations come forward voluntarily to contribute large sums to political office-seekers? Without shadow of question, every business man in America would infinitely rather stay entirely clear of politicians and political contributions if the politicians would stay clear of business men. Certainly the politicians themselves should be the last to criticise or condemn political contributions. However, pressure to make such contributions is not likely to meet with much success hereafter.

"Utility leaders and every other class of leaders in the world of finance and business should not hesitate to come forward and stand up manfully against unwarranted political misrepresentation and attacks. Any industry which allowed an injurious law to be placed on the statute books without doing everything honorable within its power to stop it would be recreant to its responsibilities to its employees, its security owners and to the public. Obviously a hurtful law should be fought before its passage—as well as after, should it be passed.

"I know of no industry, taken by and large, that has made more creditable progress in every direction during recent years than the electric light and power industry. Efficiency has been increased incalculably. Rates to consumers have been lowered during years when almost every other commodity and service has been rising in price. The industry has in almost every state so acted that regulatory bodies now find little cause for complaint. Not only so, but the utility industry has taken the lead over all other industries in the effective encouragement of employees to become stockholders and also of customers to become stockholders, a type of educational work of boundless value to the commonwealth."



GEORGE W. GILMOUR



ALDERS C. BECK



JOHN CRANSTON



JOHN J. SCHEURER



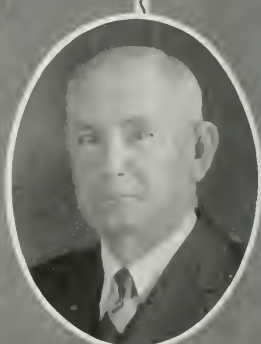
FRANK ERLANDSON



WILLIAM I. CROSSETT



E. S. BURDICK



HERMAN G. TOWLE

The "Pacific Service" honor roll. The above portraits are of eight former employees whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

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Heading the honor roll of "Pacific Service" are 90 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of eight portraits of our company's pensioners. These are:

George W. Gilmour. 78 years of age, having been born October 17, 1850. Entered the service of the Pacific Gas and Electric Company in December, 1906, and at the time of his retirement on a pension, May 1, 1928, was employed in East Bay Division.

Alders C. Beck. 72 years of age, having been born March 20th, 1856. Entered the service of the Oakland Gas, Light and Heat Company in June, 1888, and at the time of his retirement on a pension, February 1, 1928, was employed in East Bay Division.

John Cranston. 70 years of age, having been born December 8, 1858. Entered the service of the Pacific Gas and Electric Company in March, 1910, and at the time of his retirement on a pension October 1, 1927, was employed in the Supply Department.

John J. Scheurer. 69 years of age, having been born November 11, 1859. Entered the service of the Stockton Gas, Light and Heat Company in November, 1888, and at the time of his retirement on a pension July 1, 1928, was employed in Humboldt Division.

Frank Erlandson. 69 years of age, having been born December 5, 1859. Entered the service of the Pacific Gas and Electric Company in September, 1909, and at the time of his retirement on a pension May 1, 1928, was employed in the General Construction Department.

William I. Crossett. 66 years of age, having been born June 19, 1862. Entered the service of the California Electric Light Company in January, 1889, and at the time of his retirement on a pension February 1, 1928, was employed in San Francisco Division.

E. S. Burdick. 66 years of age, having been born October 8, 1862. Entered the service of the Independent Light and Power Company in October, 1902, and at the time of his retirement on a pension February 1, 1928, was employed in San Francisco Division.

Herman G. Towle. 63 years of age, having been born July 21, 1865. Entered the service of the San Francisco Gas and Electric Company in December, 1906, and at the time of his retirement on a pension July 1, 1928, was employed in San Francisco Division.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's earnings for the first half of 1928, compared with the corresponding period of last year:

	6 MOS. TO JUNE 30, 1928	INCREASE
Gross Revenue (including Miscellaneous Income).....	\$30,743,047	\$2,273,037
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals and Reserves for Casualties and Uncollectible Accounts.....	15,710,641	321,792
Total Net Income.....	\$15,032,406	\$1,951,245
Bond Interest and Discount.....	5,404,681	257,259
Balance	\$ 9,627,725	\$1,693,986
Reserve for Depreciation	2,998,356	470,399
Surplus	\$ 6,629,369	\$1,223,587
Dividends Accrued on Preferred Stock (6%).....	2,347,396	257,184
Balance	\$ 4,281,973	\$ 966,403
Dividends Accrued on Common Stock (8%).....	2,708,312	384,022
Balance	\$ 1,573,661	\$ 582,381

The foregoing statement includes six months' operations of the Western States Gas and Electric and Coast Valleys Gas and Electric Companies. Only two months' earnings from these properties are included in the period against which comparison is made.

On June 29, 1928, the properties of the Western States and Coast Valleys Companies, stock control of which was purchased from the Byllesby interests on May 1, 1927, were formally deeded to the Pacific Gas and Electric Company and thus became an integral part of its system. This again places the Pacific Company in the position of complete ownership of all of the properties which it operates.

On March 1, 1928, the Company put into effect electric rate reductions over its entire system, followed later by reductions in the territory of the Western States and Coast Valleys Companies. Lower gas rates were also put into effect, and the aggregate of the reductions in both departments exceeds \$2,300,000 per year. Coincident with these reductions there was inaugurated a vigorous selling campaign, calling for an expenditure of about \$1,000,000 per year. With the exception of a small section of territory, the Company's top rate for electric energy for domestic purposes is now 5 cents per k. w. h. in all cities and towns in which it operates, and 6 cents per k. w. h. in all rural territory, with graduated reductions down to 1½ cents per k. w. h. for larger usage. The Company's aggressive sales campaign is based on the stimulation afforded by these lower rates, and is producing the anticipated satisfactory results. The cumulative effects of this sales policy, with the continued activity of the present sales force of 350 people, should, however, be more fully reflected in the second half of the year.

The balance available for the Company's common stock, after the deduction of all prior charges, was equivalent to 6.32% upon the average amount of common stock outstanding during the first six months of the current year, compared with 5.71% in the same period of 1927.

FIRST PREFERRED STOCK PAYS ITS FIFTY-FIFTH CONSECUTIVE QUARTERLY DIVIDEND

ORIGINAL PURCHASERS HAVE RECOVERED ENTIRE PURCHASE PRICE IN DIVIDENDS

On May 15, 1928, the Company, by means of checks amounting to \$1,162,498 mailed to 30,661 stockholders, paid the fifty-fifth consecutive quarterly dividend of $1\frac{1}{2}\%$ upon its first preferred 6% stock. These fifty-five dividends aggregated \$82.50 for each share of the original \$100 par value stock, which is precisely the price at which the stock was first sold by the Company direct to the general public at the time of the original "customer-ownership" offering in 1914. Each subscriber to the initial issue who still retains his stock, therefore, has recovered the full purchase price in dividends paid thereon, and now owns a security having a market value substantially in excess of the original cost.

The advance in market price since the initial issuance of this stock is doubtless due in part to the lower average interest rates now prevailing, but also in a large measure to the steadily growing equity in both assets and earnings back of our preferred stock. The Company's investment in physical properties has trebled since 1914, its gross earnings have increased from \$17,220,504 in that year to \$60,668,849 in the twelve months ended June 30, 1928, and the balance remaining after the payment of dividends on this stock has increased during this period from \$2,030,682 to \$7,878,147. The following table shows the earnings available for preferred after the deduction of all prior charges (including depreciation and Federal taxes), and the balance over dividend requirements in 1914 and in recent years:

EARNINGS FOR PREFERRED STOCK

	SURPLUS AVAILABLE FOR PREFERRED STOCK DIVIDENDS	PREFERRED STOCK DIVIDENDS, 6%	BALANCE OVER DIVIDEND REQUIREMENTS
1914.....	\$ 2,645,666	\$ 614,983	\$2,030,683
1923.....	6,756,294	3,103,847	3,652,447
1924.....	7,028,349	3,244,609	3,783,740
1925.....	7,851,357	3,265,434	4,585,923
1926.....	8,859,240	3,488,880	5,370,360
1927.....	10,970,251	3,969,059	7,001,192
1928 (12 mos. to June 30) ..	12,609,636	4,731,489	7,878,147

The equity underlying the preferred has been increased since 1914 by the issuance of approximately \$40,000,000 par value of common stock, the preferred now taking precedence, both as to assets and dividends, over upwards of \$72,000,000 par value of common stock having a market value of approximately \$138,000,000; the market equity represented by combined preferred and common stocks being equivalent to 283% of all preferred stock issued and subscribed, or \$71 for each \$25 share.

The Company's first preferred stock has always been a sound and well-secured issue, and its investment position has improved steadily with the passing years until it unquestionably ranks as one of the strongest and most desirable utility preferred stocks in the country. The market for this stock is steadily broadening, not only through a constantly wider distribution among the general public, but by reason of the growing demand for issues of this character by large institutional investors. The New York legislature, for example, recently enacted a statute permitting insurance companies chartered in that State to invest a portion of their assets, under certain restrictions, in preferred stocks, this Company's preferred issue being eligible for such investment under the provisions of the Act.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE

PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY

245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII JULY, 1928 No. 5

Deeds for the operating and other properties of the Western States Gas and Electric, El Dorado Power and Coast Valleys Gas and Electric Companies have been passed and all those properties are now merged in the "Pacific Service" system.

Actual agreement of purchase was reached a year ago and the terms thereof approved by the State Railroad Commission, but up to July 2, when the general order was issued from headquarters, the properties were operated by our company as separate properties.

Details of the physical properties of these companies and the territory involved have already been made known to our readers. Their absorption has resulted in rate adjustments for both gas and electricity in numerous communities which will materially benefit consumers. In the city of Richmond, in Contra Costa county, for instance, the saving to customers for electric service is estimated at \$23,000; Eureka, in Humboldt county, will save \$20,000 on gas service; the city of Stockton, in San Joaquin county, \$80,000 on electric service, while in the Coast Valleys territory, taking in a large section of Monterey county and including the cities of Salinas and Monterey, the saving on electric service is estimated at \$75,000. Saving to small communities not included in the examples given will run the total to over \$200,000.

In announcing the passing of the deeds for the properties of the three companies Mr. F. A. Leach, Jr., our company's first vice-president and general manager, issued the following statement:

"The purchase of these properties immediately adjacent to the P. G. & E. system—in fact overlapping it in some instances—permits unified operation with many econo-

mies. It does away with overhead and management expense of considerable amount.

"The companies taken over bought from the Pacific Gas and Electric Company large volumes of electric power for redistribution. Their lines often paralleled P. G. and E. lines and at times entered the same field. Therefore, their acquisition constitutes a logical and economically sound extension of the Pacific Gas and Electric Company's activities.

"The reductions in rates we have been able to make to the consumers of these companies show the advantages of consolidation. If the properties had remained separate it is doubtful if any rate changes could have been made for some time to come, if at all. The result is in keeping with the history of the P. G. and E. As it has extended its service and territory it has increased in efficiency and made frequent reductions in rates. Its rates today are among the lowest in the United States.

"It is also in keeping with the policy of 'Pacific Service' to bring all newly acquired property into its own composite organization. In other words, the P. G. and E. is an operating, not a holding, company and is owned and managed in California."

The National Electric Light Association, through its statistical section, has assembled in pamphlet form some interesting facts and figures on the development and scope of the electrical industry of the United States during recent years.

The report shows that developed water power in the United States as of January 1, 1928, was 12,296,000 horsepower, showing an increase of 575,000 horsepower, or approximately 5 per cent, during 1927. At the present time the total amount of potential water power available 90 per cent of the time is 38,110,000, and that available 50 per cent of the time is 59,166,000 horsepower. "All of the increase of developed water power in 1927," states the report, "was in the plants of public utility power companies, the capacity of waterwheels in manufacturing plants showing a small decrease during the year.

"California ranks first in developed water power, with a total of 1,992,780 horsepower of waterwheel capacity. New York, with 1,779,000 horsepower, is second and Washington, with 707,000 horsepower, is third."

"The output of the electric light and power plants of the United States is nearly

as much as that of all the rest of the world combined."

The number of customers for electric light and power in the United States is shown to have doubled in the past seven years. Taking the figures as of December 31, 1927, the total number of consumers was 21,700,000, as against 10,820,000 in 1920. Of the grand total for 1927, 17,600,000 were domestic consumers, 3,400,000 commercial and 700,000 power consumers. More than 62 per cent of the people in the United States now live in homes served by electricity. Excluding farms, nearly 80 per cent of all homes are wired. The Pacific Coast shows the closest approach to complete residential electrification, and here California leads again with 92 per cent of her homes wired for electricity.

Concerning the availability and use of electric service, the report states: "The advent of interconnection and the improvements in the art of electrical transmission and distribution have rendered service available to an ever-increasing number of communities. Not only has every urban district the advantage of the supply of electricity but the smaller villages, hamlets and rural districts are being reached in steadily growing numbers.

"During the past five years, conservative estimates show a growth of over 4,000 in the number of communities reached by the lines of the electric light and power enterprises; an increase of 26 per cent. Every city of 5,000 population or above has service, 97 per cent of all communities between 1,000 and 5,000, 50 per cent of all communities between 250 and 1,000 and more than 25 per cent of all hamlets of less than 250 population.

"Through the consolidation of smaller enterprises into larger operating units, as a practical result of widespread interconnection, the number of individual electric systems, both corporate and municipal, has shown a material decrease, although the total number of communities served has been considerably enlarged. While the number of corporate systems is shrinking, the scope of their service is steadily growing. There were 33 per cent fewer enterprises operating at the end of 1927 than there were five years before, yet the number of communities served by them increased by nearly 5,000, or by 37 per cent. On the other hand, not only is the total number of municipal sys-

tems declining but the number of communities which they serve is showing a similar shrinkage. There were 21 per cent fewer municipal systems operating at the end of 1927 than there were five years before and 23 per cent fewer communities served by them."

To the foregoing we take this opportunity of adding the following facts and figures collected by our own company's statistical bureau concerning the present status of the electrical industry in California:

There were 1,672,100 central station consumers in California as of January 1, 1928, an increase of 107,300 during 1927. Of the total 1,335,900 were domestic lighting consumers, 181,850 were commercial lighting consumers and 154,350 industrial power consumers.

As of December 31, 1927, there were 77 operating companies in California, of which 53 were commercial (public utilities) and 24 municipal systems. These utilities have an installed capacity of 3,200,000 horsepower. This represents 55 per cent of the total installed capacity in the public utility plants in the eleven western states.

California with 3.3 per cent of the population produced 9.17 per cent of the total kilowatt-hour output in the United States during the year 1927 (7,355,548,000 K.W. H.). This state produced more electricity by water power than any other state in the Union. There were 6,645,934,000 kilowatt-hours produced by water power in California during 1927, representing 22.25 per cent of the total for the country. Of the total power output in California last year 90.4 per cent was produced by water power, while the balance, 9.6 per cent, was produced by oil or gas fuel.

During 1927 California led all of the states, with the exception of Montana, in the per capita production of electricity. The per capita production per kilowatt-hour for Montana was 2,020, in California it was 1,685. Montana with a smaller population has a large industrial consumption of electricity which accounts for its outranking this state.

There are more farms receiving electric service in California than in the next two highest states combined. The figures are: California, 62,000; New York, 35,600; Washington, 20,000.

California has 7.6 per cent of the total domestic lighting consumers in the United

States; 5.7 per cent of the commercial lighting consumers and 16 per cent of the power consumers.

California, with 6,674,000 horsepower of potential water power available 50 per cent of the time, is the second ranking state in this respect, Washington being first with 11,225,000 potential horsepower.

A MENACE TO AGRICULTURE

The San Joaquin County Farm Bureau has voiced decided opposition to municipal ownership of public utility enterprise, regarding it as a serious menace to the welfare of rural communities. At a meeting of the directors of the bureau held last May, the following resolution was adopted:

"Resolved: That the breaking up of existing power systems will result in higher rates in the agricultural districts. The Farm Bureau Federation hereby goes on record protesting against the plan of municipalities purchasing, through condemnation or otherwise, the distribution plants of Pacific Gas and Electric Company or other such privately owned public utility companies now serving cities with public utility service, such as light and power. No such condemnation or purchase should be allowed, unless a way can be found to protect the rural districts against damage.

"Whereas: The present rates and efficiency of service are the result of a policy of consolidation which brought about the uniform load necessary to profitable operation at a reasonable rate, we consider that without uniform loads electric service costs soon become prohibitive to most industries. We assert that universal service can be accomplished only by great systems—either privately or publicly owned—but great systems in either case covering wide areas of territory and reaping the benefits of diversification of loads;

"Therefore, be it resolved: That the proposal involved in present proceedings is a step backward. It is an effort to split apart rather than consolidate. It is a policy that means higher rates and less efficient service. The proposal is anti-social and against the interests of the state.

"Therefore, be it resolved: That we demand that those who insist upon splitting the electric service of cities away from the electric service of the state shall themselves pay for all of the costs and losses that accompany their policy, and that the city councils of municipalities add business and economic experts to their committee of investigators so as to study the finance, the economics and the business policies involved, and work out a plan by which the farmers of California shall be left undamaged."

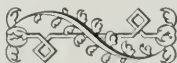
EVERYBODY'S BUSINESS NOBODY'S BUSINESS

(From the *Guerneville, Calif., Times*)

In all European countries the tendency during the past few years has been away from government ownership. The explanation is simple. Running government, state or municipally owned properties is everybody's business, because the public owns these, and what is everybody's business, we all know, is nobody's business.

It is human nature to regard in a different light the property which belongs to the state, as different from private property, and in too many cases the result is that the same interest is not shown toward the development and maintenance of state-owned property as privately owned holdings. In the case of the privately owned property, a showing has to be made for the stockholders and the plant will usually be run efficiently. If it does not run efficiently it fails and passes into other hands. But the case with publicly owned property is different. The element of politics enters in and, at any rate, if the property loses money or fails to pay a return on the investment nobody loses but the people and they do not usually realize the loss. The people always make good the loss through higher taxes and greater appropriations and there is no bankruptcy proceeding as is the case with private property.

So, until human nature is changed there can be but little doubt that the operation of our greater industries and utilities can be better handled through private than public agencies.



PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians

Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF DECEMBER 31, 1927)

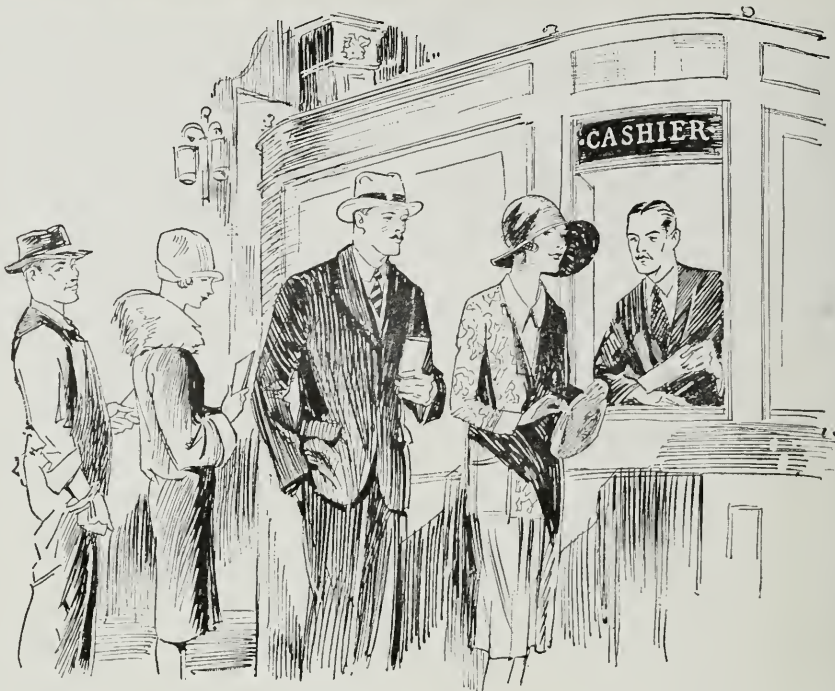
- 9,807 employed in all departments.
- \$360,000,000 capital invested in gas, electricity, railroads, steam, water and telephone plants.
- 61,000 square miles of territory in which it operates—an area greater than that of England and Wales.
- 46,068 stockholders.
- 38 counties of the state in which it transacts business.
- 967,717 consumers served with gas, electricity, water and steam.
- 2,500,000 people in 38 counties, which is approximately 50 per cent of the State population.
- 351 cities and towns in which it supplies service directly and through other companies.
- \$17,997,554 annual wages paid employees, year ending December 31, 1927.
- \$6,344,307 taxes, Federal, state, county and local, year ending December 31, 1927.
- 621,213 horsepower developed in 32 electric water-power plants.
- 206,266 horsepower developed in 9 electric steam plants.
- 827,479 total horsepower developed in 41 plants.
- 1,657,965,000 kw. hrs. sold, year ending December 31, 1927. This is equivalent to the effort of 5,526,550 men.
- 20,214,834,600 cubic feet of gas sold, year ending December 31, 1927.
- 20 gas plants.
- 17,540 miles of transmission and distribution lines. Greater than the distance between San Francisco and Bagdad, Mesopotamia.
- 4,998 miles of mains used in distributing gas. Greater than the distance between San Francisco and Mollendo, Peru.
- 925 miles of mains and ditches used in distributing water.
- 1,300 miles of track of railway supplied with electric power.
- 94,855,398,000 gallons of water storage capacity of 103 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for approximately 5 years.
- 142,842 acres of land owned in California.
- 405 parcels of property owned in cities and towns.
- 4,432,889 barrels of California Oil used, year ending December 31, 1927.
- 239,732 horsepower in agricultural motors depending on "Pacific Service."
- 775,519 horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
- 49,973 street lamps, gas and electric, lighted by "Pacific Service."
- 9,499,533 incandescent lamps nightly lighted.
- 1,926,380 horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

General Office: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



Approximately

400,000 BOND COUPONS and 200,000 DIVIDEND CHECKS

Were Cashied by the Holders of

PACIFIC GAS AND ELECTRIC COMPANY SECURITIES

During the Past Twelve Months

Every one of the hundred thousand holders of Pacific Gas and Electric Company securities receives a regular income from his investment.

These coupons and checks represented amounts payable by the Company to the owners of its bonds and stocks in return for the investment of their funds in this essential and rapidly developing enterprise. The Company's

**FIRST AND REFUNDING MORTGAGE BONDS
FIRST PREFERRED STOCK
COMMON STOCK**

afford desirable mediums of investment in one of the largest and soundest of the nation's public service institutions which, with its predecessors in title, has a record of three-quarters of a century of successful operation.

RECORD OF RECENT GROWTH

	Gross Revenue	Number of Customers	Sales of Electricity (K W H)	Sales of Gas (Cubic Feet)
1923	\$39,971,743	710,034	1,199,063,000	13,674,794,000
1924	44,935,419	763,617	1,334,035,000	15,277,478,000
1925	48,066,897	813,698	1,351,798,000	16,200,951,000
1926	51,125,990	874,724	1,514,981,000	17,482,206,000
1927	55,621,044	967,717	1,657,965,000	20,214,834,000

PACIFIC GAS AND ELECTRIC COMPANY

245 MARKET STREET

SAN FRANCISCO, CALIFORNIA

PACIFIC SERVICE MAGAZINE

PUBLISHED QUARTERLY BY THE PACIFIC GAS AND ELECTRIC CO. SAN FRANCISCO



MOKELUMNE RIVER CANYON AT SALT SPRINGS POWER PROJECT

Vol
17

OCTOBER 1928

No
6

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Pacific Service Magazine

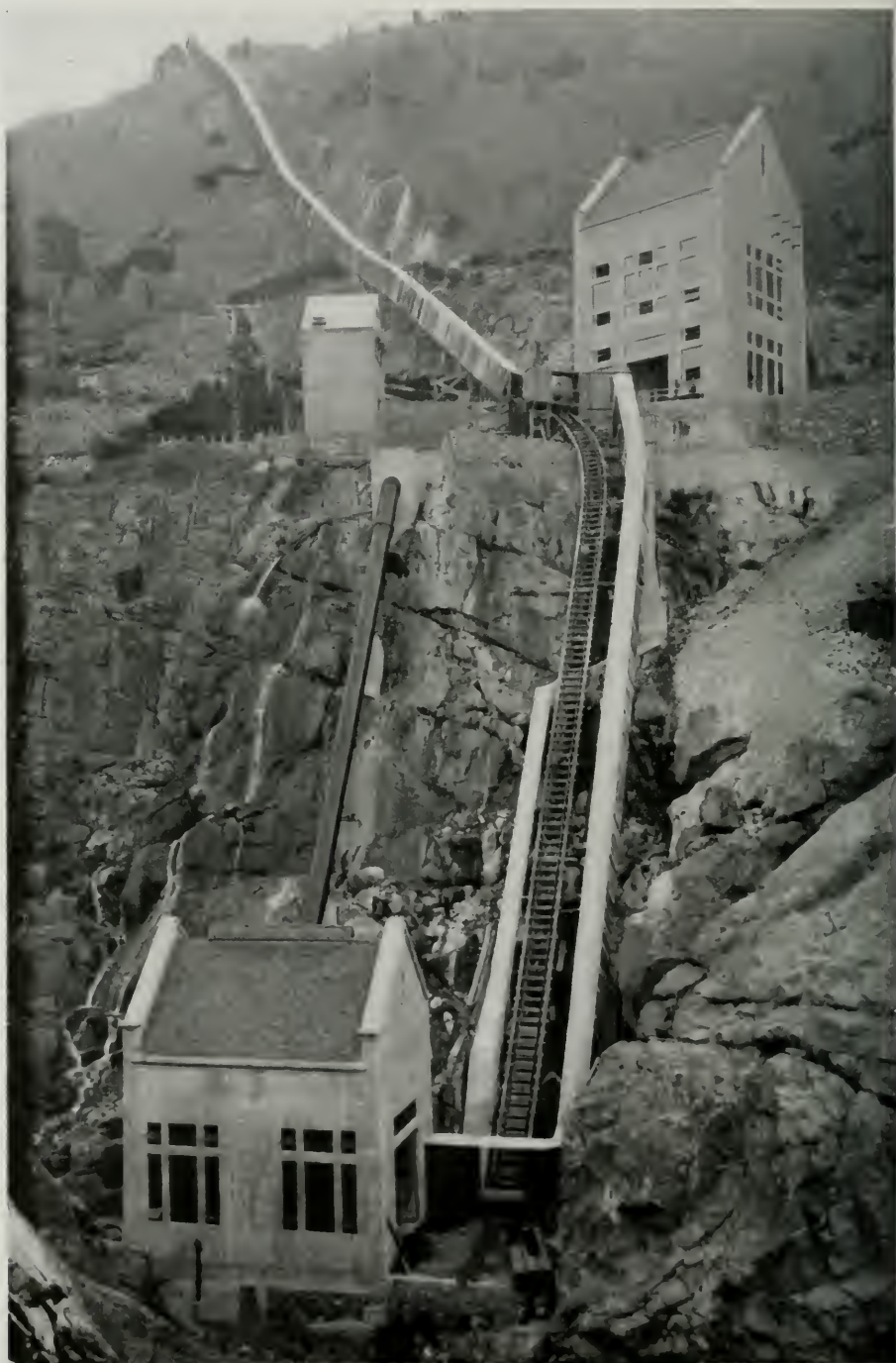
Volume XVII

Number 6

Contents for October, 1928



SPAULDING POWER-PLANTS Nos. 1 AND 2	Frontispiece
ENLARGING DRUM-SPAULDING SYSTEM— CO-OPERATIVE PROJECT AT COMPLETION	F. S. Myrtle 171
WORK IN PROGRESS AT SALT SPRINGS— PLACING ROCK-FILL IN BIG DAM	F. S. Myrtle 180
'PHONING OVER HIGH-VOLTAGE WIRES— OUR OAKLAND-TO-PIT CARRIER SYSTEM	J. P. Jollyman 187
"PACIFIC SERVICE" AND THE FARMER— RUBBER CULTURE IN SALINAS VALLEY	J. F. Pollard 190
THE WALNUT IN NORTHERN VALLEYS— DEHYDRATING BY ELECTRIC PROCESS	W. W. Shuhaw 194
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 196
EDITORIAL	198



Spaulding plants Nos. 1 and 2, as recently reconstructed. These plants are located immediately below Lake Spaulding dam and are operated by water from the tunnel which diverts the flow from the lake into Bear valley and Drum canal

Enlarging Drum-Spaulling System— Co-operative Project at Completion

By FREDERICK S. MYRTLE

The end of 1928 will witness the completion of a major construction program on the South Yuba system which was undertaken by our company in order to utilize water supplied by the Nevada Irrigation District in accordance with the terms of a co-operative contract between the company and the district, and, also, to take care of additional storage developed at Lake Fordyce, parent reservoir of the South Yuba system, through the raising of the dam by which the capacity of that reservoir has been increased from 20,000 to 46,662 acre-feet.

Under this contract the Nevada Irrigation District undertakes to deliver 108,000 acre-feet of water annually into Lake Spaulling during the nine months' period from July to March inclusive. Our company, on its part, has agreed to transport this water through its South Yuba and Drum canals, extracting power en route,



Bowman reservoir, Nevada Irrigation District. Storage capacity 67,000 acre-feet.

finally delivering the water to the district for irrigation use.

The Nevada Irrigation District has constructed a reservoir of 65,000 acre-feet capacity at the old Bowman dam site on Canyon Creek, a tributary of the South Yuba. The old Bowman reservoir is a relic of early days, having been constructed more than half a century ago, and was long used as a source of water supply for the North Bloomfield hydraulic mines. It is situated

about ten miles due north of Lake Spaulling and is the chief of a small cluster of reservoirs lying under a ridge separating the Middle Yuba watershed from that of the South Yuba. On the South Yuba side lie Meadow Lake, Lake Fordyce and Lake Spaulling, all of our company's South Yuba system. The middle fork of the Yuba River is made tributary to the new Bowman reservoir by the construction of a



Bowman-Spaulling conduit leading out of Fuller Lake.

tunnel some four miles in length through the ridge which separates Canyon Creek from the Middle Yuba. From Bowman reservoir a conduit nine miles in length with capacity of 220 second-feet conducts the water to Fuller Lake, one of our company's reservoirs, and from this a canal about a mile in length conducts the water to the crest of the ridge above Lake Spaulding, where it will be dropped through a new plant known as the Spaulding No. 3 plant, which has been constructed to develop a head of 320 feet. Upon delivery into Lake Spaulding the water will be divided, 35,000 acre-feet annually being routed through Spaulding No. 2 plant and via the South Yuba canal to our company's power-plant at Deer Creek, after which it will be delivered to the Nevada Irrigation system. The old ditch system below Deer Creek, which formerly belonged to the Pacific Gas and Electric Company and which furnishes water to the towns of Nevada City and Grass Valley and surrounding mines and farms, was purchased by the district under the terms of the contract and



Canal section of Bowman-Spaulding water conduit.

constitutes a large part of the district's present irrigation system. The remaining portion of the district's water, amounting to 73,000 acre-feet annually, will be utilized, first through Spaulding No. 1 power house for the development of power, thence transported nine miles through Drum canal, which has been enlarged to a capacity of 500 cubic feet per second, whence it will be passed through Drum power house under a head of 1375 feet. Below Drum plant this water is at the present time discharged into the channel of Bear River, which conducts it to the head of the Bear River canal.

Our company has agreed to make use of from 12,000 to 15,000 acre-feet annually



Spaulding No. 3 power-house nearing completion. Water from Bowman canal passes through power-house into the lake.

of the district's water through Halsey and Wise plants, the former located in Christian Valley near Clipper Gap, the latter in Auburn ravine, the amount depending upon the capacity which is available and on the company's need for power. The remainder of the water will be allowed to flow past the Bear River head dam and will be diverted by the Nevada Irrigation District for irrigation use further downstream. Eventually

the company will construct two power plants on Bear River to develop the 1300 feet of head which lies between Drum power-house and the Bear River head dam. The use of the district's water through these plants is provided for in the contract.

It is estimated that the district water used through the plants as at present constructed, together with additional natural flow which can be utilized, will generate an annual output of electric energy amounting to, in round figures, 190,000,000 kilowatt-hours. For the use of this water our company has agreed to pay the district approximately \$370,000 annually and this amount is estimated to go a long way towards paying the interest and sinking fund requirements on the bonds which were sold by the district to finance the cost of constructing the mountain division works. In addition to paying



Elevated metal flume at upper end of Bowman-Spaulding conduit— $2\frac{1}{2}$ miles in length.

this sum for the use of the water the company has spent about \$2,800,000 on the enlargement of its existing works and on the new construction which was necessary to utilize the additional water available.

The reconstruction project at Lake For-dyce antedated and was independent of that resulting from the co-operative agreement between the Nevada Irrigation District and our company. Lying amid the granite peaks of the Sierra Nevada near the summit, at an elevation of about 4,875 feet above sea-level, this lake is the oldest of a cluster of artificial reservoirs, twenty-one in number, that formed part of the old South Yuba Water Company's system which was purchased by our company in 1905. They were constructed in early days, together with a series of flumes and ditches, to help out the mining industry in that region and,



Launch towing barge by which machinery and supplies were conveyed to Spaulding No. 3 plant from spur track leading from Smart station to construction camp above Spaulding dam.

at the same time, to furnish water for irrigation to the counties of Nevada and Placer. When, in 1912, our company's Spaulding-Drum hydro-electric project was born, these reservoirs became sources of water supply for that system. Additional storage facilities were provided by the construction of the great dam at Lake Spaulding which, with additions made since its original construction, towers

275 feet above the streambed and impounds the waters of the South Yuba into a reservoir of 74,488 acre-feet capacity.

Lake Fordyce, parent reservoir of the system, was created in 1873, and the dam which was recently raised dates back to 1881, but was subjected to considerable re-



Gunite flume carrying water from Lake Valley reservoir across Carpenter's Flat to Drum canal.

construction work between that time and 1924, when our company's engineering forces commenced work upon a project to elevate the dam 47 feet and thereby increase the storage capacity of the reservoir from 20,000 to 46,662 acre-feet capacity, making Fordyce the second largest reservoir in the company's system. The water released from Fordyce is carried down Fordyce Creek a distance of about fifteen miles to Lake Spaulding, into which it discharges. The result of this reconstruction work, completed in 1926, was to place at the disposal of our company's electric users approximately 36,500,000 additional kilowatt-hours of electric energy annually and, also, to equalize the flow of water through the conduits below the chain of lakes terminating at Lake Spaulding against fluctuations in power demands and so enable Drum canal, Bear River canal below Drum power-house and Boardman canal and its tributaries above and below Wise plant in Auburn ravine to maintain an even flow throughout the year.

This work, taken by itself, would have necessitated some slight enlargement of the carrying capacity of both Drum and Bear River canals; but when, in May, 1924, the agreement between the Nevada Irrigation District and our company was entered into, entailing a guaranteed delivery of 108,000



Energy diffuser by which water from Lake Valley flume pours into Drum canal.

acre-feet of water annually into Lake Spaulding, a complete reconstruction and reinforcement of the Spaulding-Drum system was decided upon. Work on this project started in 1926.

To properly take care of the additional flow of water through Lake Spaulding from the Nevada Irrigation District's system, together with that afforded by the reconstruction of Lake Fordyce, our company's Engineering Department laid out a general plan which involved two main features: first, the reconstruction and enlargement of conduits for the water diverted from Spaulding into Bear valley and via Drum power plant to the head of Bear River canal; the other, work of a similar character for the accommodation of the water diverted at Spaulding by way of the South Yuba canal to our company's power plant at Deer Creek and thence to the Nevada Irrigation District's distributing system in the Nevada City-Grass Valley territory.

Taking the Drum system first, the 4,400-foot tunnel which takes the water released from Spaulding into Bear valley was enlarged by removing from $3\frac{1}{2}$ to $4\frac{1}{2}$ feet of excavation from the floor over its entire length. Below the tunnel outlet Drum canal, which has a length of about nine miles, was enlarged or im-



Slab-lined section of Drum canal.

proved to increase its capacity from 350 to 500 second-feet. This work was effected in various ways. For the most part the outside masonry or concrete lining was raised and the inside bank trimmed to a flatter slope.

Dry masonry on the outside bank was either pointed or gunited to stop leakage and increase capacity. At some points a rock wall was built on the inside slope and here and there the bottom of the canal was paved. With the exception of the Bear River and Saddle flumes, all wooden flumes were replaced with concrete flumes or with metal flumes having wooden or metal substructures. Inlets and outlets were built of concrete. The Tahoe Forest Reserve siphon was replaced by 1600 feet of reinforced concrete bench flume hav-



Metal flume on timber-trestle supports, Drum canal.

ing a 10 by 7 foot inside dimension section. The picturesque wooden flume across Pitman ravine was replaced by a reinforced concrete flume equipped with a wasteway with steel radial gates. In all, five wooden flumes were replaced with metal structures and five with concrete structures.

An addition to the flow of water down Drum canal was made by a cross-country conduit from Lake Valley reservoir, one of the oldest in our company's system, situated on the north fork of the American River. Formerly this water was diverted some distance downstream from the reservoir and carried over into old Towle canal to join the Boardman at the head of the Alta power-house penstock. The new construction diverts this water one and one-half miles higher upstream and carries it round to the Bear River country through part dirt ditch and part concrete flume to Carpenter's Flat, above Emigrant Gap, across which it is conveyed by a pipe line two and one-half miles in length, crossing under the railway near Emigrant Gap and discharging into Drum canal at a point about 1200 feet below the outlet of Spauld-



Gunite facing to rock wall, section of Drum canal.

ing tunnel. It is estimated that under the former construction, which entailed a conduit of about sixteen miles, an average of 4,000 acre-feet was lost en route annually through leakage. By the new route, which is shorter and of modern construction, there will be little or no loss and the benefit to electric consumers is estimated at about 5,000,000 kilowatt hours annually.

Our company has constructed a broad road along the right bank of Drum canal which runs from its be-



Pittman concrete flume and spillway, replacing old wooden structure.

ginning to within an appreciable distance of its termination at Drum forebay. It is worth while to take this trip, for the scenery is of the true Sierra Nevada type and the traveler is afforded an opportunity to view for himself the various types of construction, in the way of canal lining and flume.

Arriving at Drum forebay, a new grizzly tower has been constructed to improve conditions at the intake. The penstock tunnel leaving the forebay has been lined. The lower portion of a second penstock for the Drum plant was built in 1924 and connected to the first by means of a wye. In the new construction this second penstock was completed from the wye to Drum forebay. It is laid on concrete piers and held in place by concrete anchors. For Drum power-house a new generating unit of 20,000 horsepower has been installed. This consists of an Allis-Chalmers horizontal 20,000-horsepower generator, connected to a Pelton single overhung impulse wheel. The total electric generating capacity of Drum plant is now 70,375 horsepower.

The water from Drum, as already explained, flows down Bear River to the head of Bear River canal. At the present time it is contemplated to enlarge Bear River canal to a capacity of 350 cubic feet per second. This, it is estimated, will take care of the additional storage developed at Lake Fordyce and, also, the flow of 12,000 to 15,000 acre-feet per annum of district water through Halsey and Wise plants, as pro-



Tahoe concrete flume, replacing old wood-stave siphon.

vided for in the present agreement with the district. The balance will flow on down Bear River and be diverted by the district for irrigation purposes.

The reconstruction work required for the accommodation of water diverted at Spaulding into South Yuba canal and carried thereby by Deer Creek was of less elaborate character. It embraced some enlargement

work on the canal which consisted principally of the addition of side boards on the wooden flumes. Reconstruction of Deer Creek plant consisted principally of rewinding the generator and converting the plant to a semi-automatic operation.

So far, with the single exception of the new generating unit at Drum, only the water features of this project have been discussed. But the opportunities for additional power development at Lake Spaulding were not to be overlooked. Accordingly, three power projects were developed. First, as part of the Spaulding-Drum system, Spaulding No. 1



All-metal flume on steel supports, Drum canal.

plant was reconstructed throughout. This plant was part of the early Spaulding-Drum construction and was housed in an adit of the Spaulding outlet tunnel, with electric generating equipment of 5,000 horsepower. In the reconstruction a Pelton vertical turbine of 9,000 horsepower was installed, connected to a General Electric vertical generator of 8,000 k.v.a. or 10,700 horsepower capacity. Outside of the cave housing turbine and generator a new building was constructed on the hillside overlooking the stream in which were housed switchboard, switches and 60,000-volt transformers for both Spaulding No. 1 and No. 2 plants. The additional flow of water through Spaulding tunnel, therefore, was utilized to develop an increase of 5,700 horsepower over that afforded by the plant as originally constructed.

Spaulding No. 2 plant, located in the river bottom beneath the other and taking water out of the tunnel upstream from the adit, with the advantage of an additional head of 132 feet, as originally constructed had a generating equipment of 1,340 horsepower. This equipment has been removed

and the original apparatus in Spaulding No. 1 installed in its place. There has also been built a reinforced-concrete steel-frame building which houses the generating equipment.

Last, but by no means least, it was decided to take advantage of the flow of water from the ridge level of Spaulding canal into the lake by the construction of an entirely new plant to be known as Spaulding No. 3. With the volume of water released from the canal and the drop of 320 feet down the hillside, a plant of 9,400 horsepower capacity was planned. A forebay, consisting of a concrete header box, was constructed at a point approximately 1,650 feet distant from the projected power-house. This diverted the water from the conduit to a steel penstock, 63 inches inside diameter, laid down the hillside to the power-house. A power-house of reinforced concrete, steel frame, measuring 48 ft. 5 in. by 70 ft. 3 in., was erected on the shore of the lake. The equipment installed consists of an 8,000-horsepower horizontal Francis type reaction turbine direct connected to a General Electric 7,000 k.v.a., or 9,400-horsepower, generator. The auxil-



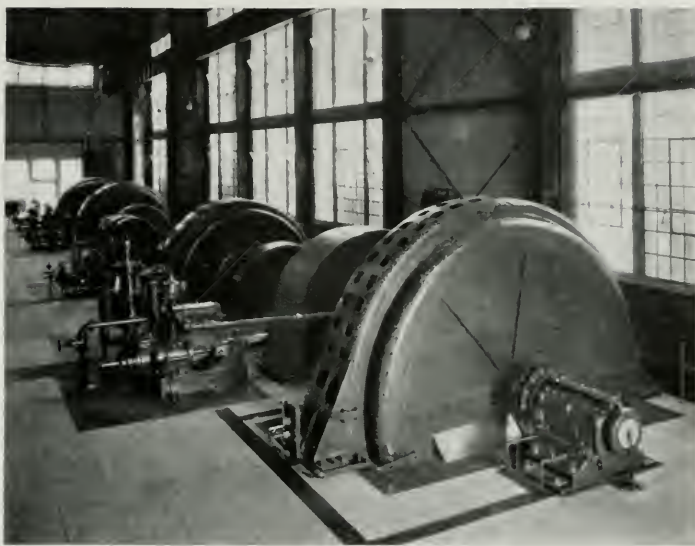
Drum power house, showing recently installed air-washers in front of the building.

ary equipment consists of relief valve, inlet butterfly valve, an automatic, hydraulic, cylinder-operated shut-down device connected to the turbine gate mechanism, which will take the place of a governor, a 125-volt direct-connected exciter, automatic switching equipment, 66,000-volt lightning arrester, and four single-phase, outdoor, water-cooled, 2,500 k.v.a. transformers. The plant was designed for

complete automatic operation without manual attendance and will be started and stopped by closing and opening a 60 k.v. oil circuit-breaker at Spaulding No. 1 powerhouse, approximately $1\frac{1}{2}$ miles distant.

The scene at the lake recalled early days of dam-building at Lake Spaulding. The old spur track leading from the Southern Pacific station at Smart, in the snowsheds east of Emigrant Gap, was brought into play and men, materials and supplies transported thereover to the lakeside overlooking the dam. From that point transportation across the lake to the site of the new power-plant was effected by means of a barge towed by a launch which made trips to and fro all day long. A new construction camp on the hillside overlooking the dam sprang into existence and 200 workmen were housed thereat. The workmen made their daily trips to the scene of their activities by launch. The plant itself was of speedy construction. Work was started in February last and it is expected the plant will be in full operation early in November.

This project of co-operation with the Nevada Irrigation District resembles, in its general features, that brought to completion last year in the San Joaquin valley region, when our company established the Melones power-plant on the Stanislaus River, a short



Interior of Drum power-house. Recently installed fourth generator in foreground.

distance below Melones dam, under a co-operative agreement with the Oakdale and South San Joaquin Irrigation Districts, whereby our company undertook to pay for use of the districts' water a sufficient amount to take care of the bond issue by which the districts were enabled to finance their water project. That enterprise proved eminently satisfactory to all concerned and received general popular approval. It set a new mark in the establishment of relations of mutual interest and understanding between the power and agricultural interests.

This present project bids fair to receive similar approval. Public men have endorsed it. At a meeting of citizens held in Grass Valley last August three high state officials, Attorney-General U. S. Webb, State Bank Superintendent Will C. Wood and State Engineer Edward Hyatt, comprising the State Bond Certification Commission, made addresses upon the financial problems confronting the Nevada Irrigation District. It was their opinion that the district's project was based and its possibility of success from the financial standpoint dependent upon the principle of co-operation with the Pacific Gas and Electric Company. Without such co-operative feature, the citizens were told, the district could not have existed; without it the district must cease to exist.

Work in Progress at Salt Springs— Placing Rock-Fill in Big Dam

Construction work upon our company's Salt Springs water and power development in the upper reaches of the north fork of the Mokelumne River, near the border line of Alpine County, has been in full process since the beginning of the present year.

A well-equipped construction camp has been established on Dead Man's Flat, on the south or Calaveras County side of the river, a short distance below the downstream toe of the projected Salt Springs dam. Rock is being quarried from the hillside towering above the Amador bank of the river and a powerful electric shovel is at work loading trains from which great boulders are rolled onto the north abutment of the dam. A temporary diversion dam has been constructed at the upstream end of the work and the waters of the Mokelumne diverted into a 1200-foot tunnel, 19 feet in diameter, bored through the solid rock on the north side of the stream. At both ends of the dam site shovels and trucks are at work clearing the river bed of debris. The next thing in order will be the construction of a concrete cut-off wall at the upstream face of the projected dam and this, with about 15 feet of permanent structure above it, is expected to be completed this fall in order to protect the river bottom from the winter storms.

A comprehensive article describing this Salt Springs development appeared in the October, 1927, issue of *PACIFIC SERVICE MAGAZINE*. It starts at a point in a gorge on the Mokelumne River north fork of the

about fifty miles upstream from our company's 26,000-horsepower plant at Electra, which lies on the north bank of the stream distant some eight miles from Jackson, the county seat of Amador. It takes its name from Salt Springs lake, a picturesque body of water fed by subterranean springs and nestling among lofty eminences in a gorge of the river some six miles above the storage project. The work now under construction is planned to provide increased power and water facilities for the Electra system, and its major features, as outlined in the article referred to, include the construction of a rock-fill dam 300 feet in height above the stream, 1300 feet in crest length and measuring 800 feet from upstream to downstream toe, a structure that when completed will be the largest of its kind in the world and which will impound the waters of the Mokelumne into a reservoir of 130,000 acre-foot capacity; construction of a water conduit from the tunnel intake of the dam a distance of, in round numbers, twenty-five miles to the point where Tiger Creek flows into the Mokelumne, and where a small



The 4-yard electric shovel at the quarry overlooking the dam site.

dam across the river marks the intake of the Upper Standard Canal, one of the two main feeders of the Electra system; erection of a hydro-electric plant of 75,000 horsepower capacity on the north bank of the river at the point of its junction with Tiger Creek, where there is a drop of 1200 feet from the line of the water conduit from Salt Springs; enlargement of the Upper Standard Canal in order to accommodate the additional flow of water from Salt Springs.



The 4-yard electric shovel loading rock in the quarry.

To these major features as heretofore described may be added the following: Construction of another storage reservoir of 35,000 acre-feet capacity on Bear River, a stream which pours down the hill on the north or Amador side of the Mokelumne and joins it some four miles below Salt Springs; construction of a power plant of 39,000 horsepower capacity at the lower end of the discharge tunnel at Salt Springs dam, its water supply to be taken in part from Salt Springs reservoir, in part from Bear River reservoir, the power there generated to be transmitted down river and merged with that generated at Tiger Creek powerhouse and other plants of the Electra system; reconstruction and enlargement of the Electra plant to a capacity of 75,000 horsepower to receive the increased flow that will be made available by the new storage facilities.

There is a project, also, to construct an addition to the Blue Lakes water system, in Alpine County, which was the original source of supply for Electra, by the construction of a reservoir of 9,412 acre-feet capacity in Deer Valley, at a point some four miles downstream from the cluster of reservoirs known as "Blue Lakes." This latter project is held in reserve for the time

being, but the others mentioned are integral parts of the construction work now in process.

The projected Bear River reservoir will be located about two miles below an existing one of 6,712 acre-feet capacity that is a part of the Electra system as originally constructed. There will be a dam 200 feet in height and of concrete arch type, with a lower section of multiple arch type, and the water released therefrom will be brought through a 2½-mile tunnel and a 4,500-foot pipe line to a point near the outlet of Salt Springs dam, where it will serve to operate one unit of the projected Salt Springs plant under a head of 2100 feet, nearly 200 feet higher than any other plant on the "Pacific Service" system. The other unit of the Salt Springs plant will take water from the Salt Springs reservoir under a variable head having a maximum value of 240 feet, the volume of water passing through the tunnel making up for the comparatively low head. Combined, these two units will be capable of furnishing 39,000 horsepower of electric energy. All the water passing through the Salt Springs plant will be diverted into the concrete bench-flume conduit running from the tunnel outlet to the point above Tiger Creek from which it will be dropped 1200 feet to the powerhouse to be located at that point.

Below the Tiger Creek powerhouse will be constructed an afterbay, at which the water will again be diverted from the river into Upper Standard Canal down which it will be carried a distance of twenty-two miles to the Petty reservoir on the height overlooking Electra powerhouse. The capacity of the present canal will be enlarged for the purpose to a capacity of 525 cubic feet per second. From the Petty reservoir the water will be dropped approximately 200 feet through pressure pipes to a powerhouse to be located on the rim of the existing Tabaud reservoir. This powerhouse will be of 10,000 horsepower generating capacity. The Tabaud reservoir will serve, as it does now, as a forebay for the Electra plant, which lies on the brink of the river some 1250 feet below. This plant will be entirely rebuilt, the reconstruction features including a new powerhouse, generating equipment of modern design and of the capacity stated above, new penstocks, transformers, switches, everything new and up to date.

A word about transmission facilities. It has been decided that the power generated at Salt Springs plant shall be transmitted at 110,000 volts to Tiger Creek powerhouse, there to be stepped up to 220,000 volts for transmission by a double-circuit steel tower line to Electra and on through Stockton and the Livermore valley to our company's high-tension distributing station at Newark, at which point it will be merged in the "Pacific Service" power pool.

For some time to come, however, the main efforts of our company's construction gangs will be devoted to the work of clearing bedrock and filling in the space to be occupied by the dam. When it is considered, as before stated, that the structure will rise 300 feet above the surface of the stream, will have a crest length of 1300 feet and will measure 800 feet in width at bedrock, it will be realized that the filling-in process is no small task. As a matter of fact, it is estimated that 3,000,000 cubic yards of material



Dumping rock onto the north abutment of the dam.

will be required, a volume more than equal to the aggregate cubic content of twenty-four buildings of the size of our company's general office building in San Francisco. This filling-in process, therefore, is calculated to occupy about two and one-half years, in all. When this is done the upstream surface of the structure will be protected by a water-tight facing of reinforced concrete graduating from a thickness of three feet at the bottom to one foot at the top. Underneath this will be a layer of derrick-placed rock fifteen feet in thickness.

In order, however, to protect the structure against seepage, a trench about four feet wide and from twelve to fifteen deep will be excavated below bedrock along the entire upstream face of the dam. This cut-off trench will be filled with concrete to bedrock surface, above which level a concrete facing heavily reinforced and laid against the fifteen-foot thickness of placed rock, will be carried to the top of the upstream face. In this manner a complete water-tight skin or seal will be provided, preventing the movement of water into or through the dam itself. The slope of the upstream face will be carried at an angle of 1.4 feet horizontal to each foot of elevation. The full height of the dam when completed, taking into account the construction work from below bedrock to the surface

of the stream, will be 335 feet in all.

Work started on this development in the spring of 1926. The first thing done was to establish means of transportation from the nearest thoroughfare, namely, the Alpine highway running along the ridge above the river, to the dam site. The point selected was a forest ranger's station upon the highway 37 miles out from Jackson where the elevation is 6,500 feet above sea-level. An old road plunging down a slope a distance of five miles to a ranch was made use of and by aid of dynamite, drills and power shovels was carried down to the Bear River crossing, a drop of about 3,000 feet, from which point a way was constructed along the north bank of the river to Dead Man's Flat. Distance from the highway, twelve miles.

This road served for awhile, but owing to its elevation would not be available during the winter storm period. Our engineers, therefore, decided to build an entirely new highway branching off from Barton's, a point eighteen miles nearer Jackson and

where the elevation is only 3,300 feet, and winding its way to the Bear River crossing before mentioned by way of Tiger Creek, turning at the old Tiger Creek sawmill that was a part of the original Electra construction project and following the devious course of the ridge to join the original road at Bear River. This road was completed in the late fall of last year. It is wide and well constructed, surfaced with crushed rock and solid enough to stand wear and tear at all times of the year. Distance from Barton's to Dead Man's Flat about 29 miles. Since the completion of this road the preliminary one from the forest ranger's station has been abandoned.

In September of last year work on the permanent construction camp at Dead Man's Flat was started. It was completed in the early spring of this year. The ground was cleared and filled in along the river front. Bunk houses, eighteen in number and each capable of housing twenty men, were built at various points on the hillside. Along the front were constructed all necessary build-



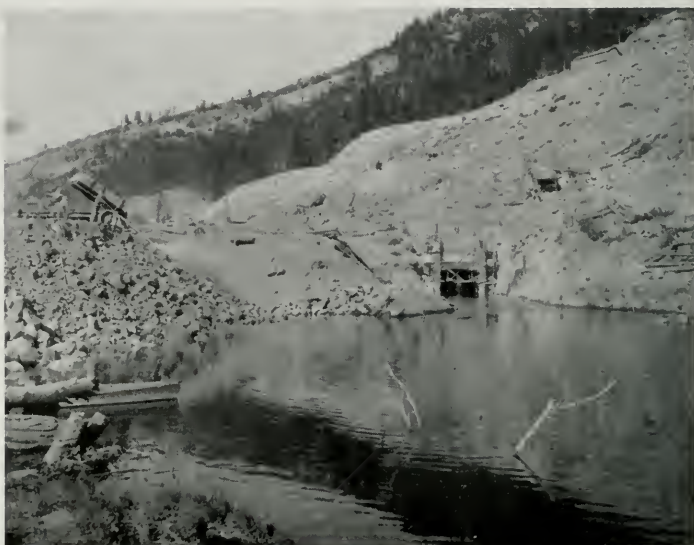
Looking upstream from the site of Salt Springs dam, showing temporary diversion dam on the right.

ings, including two office buildings, garage, machine shop, compressor-house, warehouse, oil-house with gasoline storage, electricians' and plumbers' shops; dining hall capable of serving 250 men, pool hall, recreation hall where motion pictures are shown weekly, commissary. To these add a guest-house, six cottages for the families of employees on the job and a commodious and fully equipped hospital.

This hospital is worth a passing mention. It is equipped with eight beds, operating and treatment rooms. Modern x-ray apparatus has been

installed, also high frequency apparatus for violet ray and diathermic treatments. There is also a large therapeutic lamp of 1,000-watt power and an adequate supply of surgical instruments of all kinds. Dr. W. E. King, who occupied a similar position at the Pit River construction camps, is in charge, with Mrs. King acting as stewardess. All physical examinations of employees are made at the hospital. It is of record to date that there have been no contagious diseases and no deaths; it is not to be expected, however, that construction work of the kind now in process can be unattended by minor injuries, such as lacerations and occasional fractures, so there is work to do for those in charge. An up-to-date hospital of this kind, with prompt attention at any and all hours of the day, is surely a valuable asset to a construction camp like that at Salt Springs.

When all was ready construction work started with the opening up of quarries in the rocky hillsides on both sides of the stream. Actual work, however, is for the present confined to the quarry on the north



Entrance to the 1200-foot tunnel on the upstream end of Salt Springs dam.



Tunnel exit on the downstream side.

side, where a giant electric power shovel mounted on caterpillar traction and operating a dipper of four cubic yards capacity is at work lifting the rock quarried from the granite bluff and dumping it into cars for conveyance to the dam. It is operated by one man. A railroad line has been laid from one point to the other along a level about 150 feet above river bottom, and dump cars drawn by electric locomotives carry the rock to the place where it is rolled onto the north abutment of the dam. This work was started in February and was prosecuted all through the winter. No difficulties were experienced, the greatest depth of snow not exceeding eighteen inches at one time.

The work of boring the tunnel through the north hillside from end to end of the dam was started last December. Its course involved two angles, which accounts in part for its total length of 1200 feet. It was completed in August, concrete-lined throughout. The river was diverted into the tunnel at the upstream end by a crib dam, constructed of timber, rock-filled, and twenty feet in height.

Since spring of the present year several power shovels and a fleet of trucks have been at work on the river bottom at the base of the dam site excavating and removing debris. In general the debris consists of boulders with sand and gravel intermixed, many of them so tightly packed as to require the use of explosives to dislodge them. To date over 200,000 cubic yards of debris out



The tunnel is concrete-lined throughout.

of an estimated total of 250,000 has been removed. The depth of stripping varies from twenty to forty feet. Much of the large rock has been hauled by the trucks into permanent position along the north bank of the river, to be made use of in the filling-in process at the north abutment of the dam.

As the important work of clearing the dam site nears completion greater energy is now being directed to quarrying operations, so that an abundance of suitable loose rock may at all times be available for the power shovels to load into the trains. Primary drilling in the quarry is done by electrically operated well-drill rigs, which are able to bore holes of 6 inches diameter in the solid granite for depths of from 60 to 150 feet or more.



Shovels clearing bedrock at the downstream toe of the dam.

When a row of fifteen or more of these has been drilled the holes are loaded with dynamite and are shot simultaneously, with the result that thousands of cubic yards of rock are broken up at one time. Some of the pieces are so massive as to require a second drilling with air-operated rock drills before even so giant a monster as the four-yard shovel can handle them.

Construction of the water conduit from the dam downstream and the Tiger Creek plant are matters for future consideration. At the site of the Tiger Creek plant a bank of transformers has been installed and here the power transmitted at 60,000 volts from Electra powerhouse is stepped down to 17,000 volts for construction purposes.

The entire engineering details of this project, including location, size and type of dam, reservoirs, conduits, powerhouses, etc., were worked out by our company's Depart-

ment of Engineering, under Mr. A. H. Markwart. Construction work is being prosecuted by our company's Department of Electrical Construction and Operation, under Mr. P. M. Downing. Mr. O. W. Peterson is engineer in charge of construction; Mr. G. W. Wehrle, general superintendent; Mr. P. I. Kurtz, resident superintendent; Mr. R. D. Reeve, resident engineer; Mr. A. P. Christianson, general foreman; Mr. R. B. Gray, field accountant. Mr. Grover Green represents the Engineering Department as field engineer with headquarters at Jackson. At the present time there are 250 men employed on the job.



Salt Springs lake, from which our construction project derives its name.
Situating six miles above the dam site.



View of the construction camp at Salt Springs development

Phoning Over High-Voltage Wires— Our Oakland-to-Pit Carrier System

By J. P. JOLLYMAN, Chief of the Division of Hydro-Electric and Transmission Engineering

In a system such as that of Pacific Gas and Electric Company, where electricity is generated in many separate hydro plants, from one hundred to two hundred fifty miles distant from the principal points of use as well as in steam plants in the large cities, instant communication between the Load Dispatcher in Oakland and the important generating plants is essential. The output of each plant must be co-ordinated to the demand. Transmission lines must be taken out of service, at times, for maintenance work and then restored to service. Emergencies must be met and service once interrupted must be restored as promptly as possible.

The telephone best meets the requirements for communication. It is prompt. Anyone can use it. Orders may be issued and acknowledged within very short intervals. From the very beginnings our power lines have been paralleled by telephone lines for dispatching purposes.

The amount of energy transmitted by a high-voltage power circuit is enormously greater than that transmitted by a telephone circuit. A power circuit may carry one hundred thousand kilowatts, whereas a telephone receiver requires but one-one-hundred-thousandth of a kilowatt for a good signal. The power circuit is surrounded by a powerful electric and magnetic field of force which tends to interfere with the operation of a parallel telephone circuit. Great precautions have to be taken to make possible the operation of a telephone circuit parallel with and close to a transmission line.

For a long time the joint use of a circuit for power and for communication seemed impossible, not only because of the enormous difference in the amounts of energy employed but, also, because of the fact that the frequencies employed in the power system were within the audible range. A telephone receiver connected to a power circuit through an energy-reducing device emitted a low-

pitch hum which utterly drowned any voice currents which might be present.

The development of the use of high frequencies, well above either the power or voice range, for radio communication provided a means for joint use. As is well known, the high frequency, or radio frequency, waves can be made to act as carriers of voice frequencies. This is the basis of modern radio.

The problems of joint use include not only the problems of space radio but, also, the problems of introducing the high frequency waves into the power circuits at the sending point and of detecting their presence at a receiving point.

The establishment of satisfactory com-

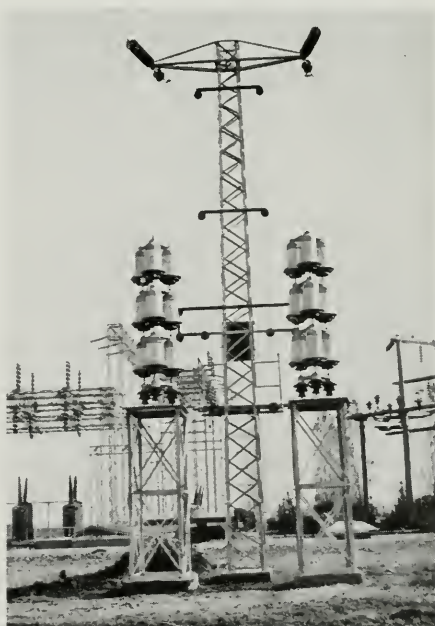


Fig. 1—110,000-volt condensers at Vaca substation, which couple the carrier currents to the power transmission lines.

munication with our Pit River hydroelectric plants presented more than usual difficulties. The distance from headquarters was greater than any heretofore encountered. The Cascade Mountains east of Redding, with their heavy forests, had to be crossed at a summit elevation of over 4000 feet. Deep snows in winter bring down many limbs of trees with consequent interruption to telephone lines near them. The situation emphasized the desirability of using the Pit power transmission lines for communication if possible. Here were lines of exceptional strength traversing a right of way cleared of trees. Every precaution had been taken to insure continuity of service.

During 1923 an experimental installation of a carrier telephone circuit superimposed on the Pit Transmission from Vaca to Pit was undertaken. The equipment was comparatively simple in character and provided a means of emergency communication. The



Fig. 2—The 110,000-volt coupling condensers at Claremont substation.

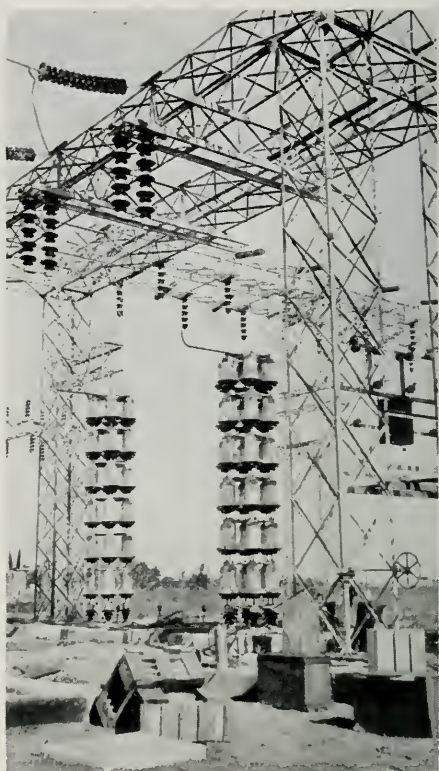


Fig. 3—The 220,000-volt coupling condensers at Vaca substation.

quality of speech was poor, however, and transmission was slow due to the necessity of manual switching for sending or receiving. By 1924 progress in the art gave promise of material improvement in the service that could be expected from the "carrier"; accordingly, work was started on the collection of information looking toward the improvement of the carrier circuit and its extension to the Load Dispatcher in Oakland.

To reach Pit from the Dispatcher's office required five miles of underground telephone circuit from that office to Claremont Substation; equipment at Claremont for generating and receiving the proper high frequency carrier currents, together with the condensers for introducing these currents into the 110,000-volt transmission system; similar equipment at Vaca-Dixon for receiving from the 110,000-volt system and transferring the carrier to the 220,000-volt

system; finally, equipment at Pit No. 1 for receiving from and sending to the 220,000-volt system.

Many problems occupied the attention of the engineers for months. The problem of passing through both the 220,000 and 110,000-volt systems and of transferring carrier energy from one to the other at Vaca-Dixon was not easy of solution. For a time, great difficulty was encountered in securing a quiet telephone circuit over the 220,000-volt system, but this was finally secured by developing a type of carrier never heretofore employed for joint use purposes. Success was finally achieved and the carrier telephone system connecting Pit No. 1, Vaca-Dixon and Claremont, with an extension to the Load Dispatcher in Oakland, was placed in operation this year.

The scheme of operation of the carrier system is interesting. The voice enters a standard telephone transmitter and causes a variation in the electric current flowing therein. This "voice current" is used to modulate a high frequency current which is then filtered to remove the undesired components. The high frequency filtered current is used to modulate a current of still higher frequency which is again filtered to remove unwanted elements. The twice modulated and twice filtered current is then greatly amplified in strength and applied to the power line by condensers, through

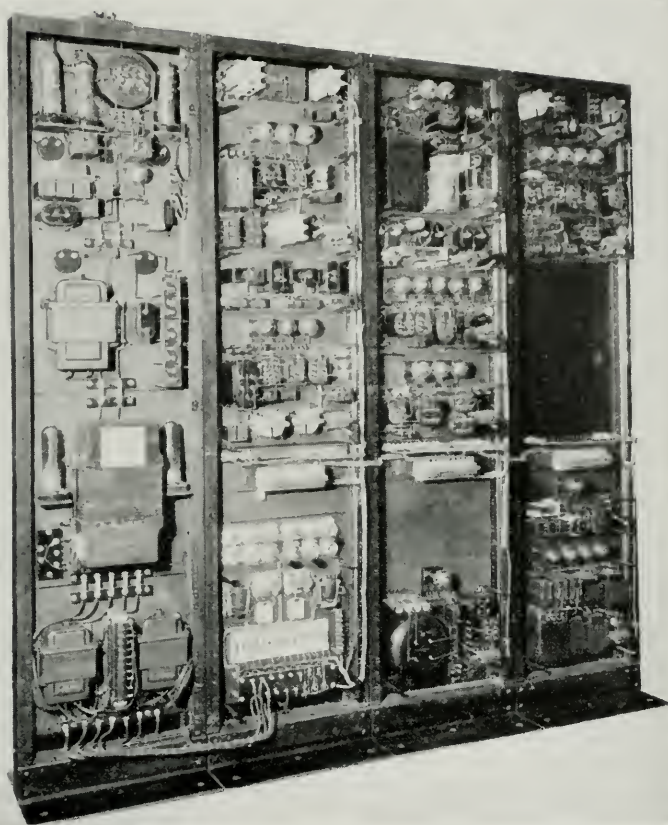


Fig. 4—Rear view of the carrier telephone panels at Vaca. The vacuum tubes, condensers, reactance coils and other devices for generating the high frequency carrier currents are shown.

which it passes readily because of its high frequency. See Figs. 1, 2 and 3. At the receiving station a reverse process takes place and finally voice currents appear in the telephone receiver as true to the original voice as in any telephone circuit. The devices for accomplishing the desired results are shown mounted on the rear of the panels in Fig. 4.

Three-element vacuum tubes similar in principle to those used in radio receiving sets are used as generators of high frequency currents and as amplifiers. Electrical filters consisting of an assembly of condensers and reactance coils made to the most exacting standards are used, together with many special devices developed in the telephone industry.

"Pacific Service" and the Farmer— Rubber Culture in Salinas Valley

By JAS. F. POLLARD, *Manager Coast Valleys Division*

Our company's recent acquisition of the properties of the Coast Valleys Gas and Electric Company has added to the "Pacific Service" territory a large area susceptible of considerable agricultural and industrial expansion.

The area in question runs from the foot of the San Juan grade, eight miles north of Salinas, to a point south of San Ardo, a distance of about 78 miles as the crow flies, and takes in the length and breadth of the Salinas valley. It is already the center of much agricultural activity, and through it run the transmission lines of the former Coast Valleys Company from its high-tension distributing station at Salinas.

At the present time Salinas substation receives electric energy from two points, by two 60,000-volt lines from Port Marion and by a 100,000-volt line from Manteca. To these will shortly be added a 100,000-volt steel-tower line from our company's distributing substation at Newark to a substation now in process of construction at Morgan Hill. This line is expected to be in operation before winter and will subsequently be extended to Salinas. In this way not only will reliability of service be insured to present consumers but, also, provision made for future development.

Dairy-farming is a staple industry in that region, and there is considerable acreage devoted to agricultural development of various kinds. In the vegetable line the lettuce industry is worth more than passing mention, and in the way of fruit-growing a prominent instance is furnished by the spacious holdings of the California Orchard Company. But an industry that is unique in its prosecution in this part of the western world is the cultivation of the guayule rubber shrub, a plant which in appearance resembles rather closely common sagebrush.

The Intercontinental Rubber Company of New York made the first experimental plantings of guayule in Coast Valleys territory in 1912 and ever since then has been



Guayule rubber. One-year-old seedling plant.

working continuously with testing, propagating and eliminating unproductive strains for the purpose of developing a species of this shrub that will grow readily under California conditions and will produce a high percentage of rubber content.

For the past three years this company has maintained an extensive nursery, laboratory, rubber extraction testing plant and general experiment station on a tract of land lying about four miles east of Salinas.

More than 2000 different strains of seed were obtained from wild shrubs which grow in profusion on high desert lands in Mexico and these have been reduced as a result of the experiments carried on at this station to some six strains that are readily propagated and grown on a commercial basis in Califor-

nia. The Intercontinental Rubber Company maintains four factories in Mexico for the purpose of extracting rubber from wild guayule gathered on the desert lands of that country.

According to Dr. D. T. MacDougal of the Carnegie Institution of Washington, the earliest knowledge of the use of rubber is supplied from Mexico. In a treatise upon the subject Dr. MacDougal writes: "Companions of Cortez returning to Spain early in the 16th century told Peter Martyr of the Royal Council of Indian affairs of a game of tennis popular among the people of southern Mexico. It was said that 'Their balls are made of the juice of a vine that climbs over the trees, as hop vines clamber among the hedges. They cook the juice of these plants until it hardens in the fire, after which one shapes the mass as he pleases, giving it the form he chooses. It is alleged that the roots of this herb, when cooked, give them their weight; at all events I do not understand how these heavy balls are so elastic that when they touch the ground, even though lightly thrown, they spring into the air with the most incredible leaps.' This, with other information as to water-proofing cloaks of matting of fiber, consti-



Plants are grown from seed in nursery and when a year old are transplanted into fields.

tutes the earliest knowledge of the use of rubber."

Until recent years, however, the world's supply of rubber came almost entirely from the sap of hevea trees of the tropical lands of Brazil and the Far East. It was not until 1876 that the attention of the American people was first drawn to the Mexican product by the shipment of samples of rubber prepared from the guayule shrub from Durango in Mexico to the Centennial Exposition in Philadelphia. Even then it was not until the close of the century that any quantity of this material was isolated for test purposes. In 1902 commercial operations were commenced in Mexico, and in the following year Mr. William A. Lawrence

patented a mechanical process based upon subjecting shrubs that had been previously masticated to pressure and friction in the presence of water. These basic principles have been employed in producing over 95 per cent of all guayule rubber thus far marketed. In 1904 the first commercial shipment of guayule rubber was made to the Manhattan Rubber Company and two years later the Intercontinental Company sprang into existence, Thomas Fortune Ryan being its first president. This com-



Transplanting machine, capacity upwards of 10,000 plants daily.

pany now accounts for about ten million pounds annually, somewhere in the neighborhood of one per cent of the world's consumption. It has produced, all told, about 150 million pounds during the 22 years of Mexican operations.

The wild guayule growths, however, cover only about 130,000 square miles in northern Mexico and southern Texas and, according to the scientists, could not manage to yield a sustained production of more than 5,000 tons of rubber annually. So, when it became evident that attempts at a greater production from wild plants would mean a dwindling industry, a serious scheme for research and experimentation was undertaken to bring the wild plant into cultivation elsewhere. In 1911 Dr. W. B. McCallum, a scientist of experience, was employed by subsidiaries of the Intercontinental Rubber Company to carry on in Mexico certain phases of botanical study and propagation work that had previously been started by Mr. Francis E. Lloyd, a famous expert. Revolutionary disturbances caused suspension of work and Dr. McCallum was instructed to salvage a large and representative



Field of guayule shrub, at end of second growing season.

seed supply and start over again in California. In 1912 he made experimental plantings on Monterey bay and ever since that time has devoted himself to the problem of refining and improving upon the process of rubber culture.

All the early products derived from the guayule shrub were of soft, sticky character. They were usually shipped in the wet, as no means was then known of commercially drying the rubber and yet preserving its quality. Furthermore, great difficulty was at first experienced in vulcanizing the material derived from guayule, so that grave question arose as to whether the product was actually rubber at all. One by one, however, the difficulties incidental to the preparation and utilization of guayule rubber have been overcome and, although the

work of experimentation still goes on, a foundation has been laid and a rubber prepared from the guayule shrub, by relatively simple means, which compares favorably with the best grades of plantation rubber in its capacity to vulcanize and in its tensile elongation properties after vulcanization. Following is an outline of the means by which the product is isolated from the shrub at the present time:

The whole shrub, root as well as branches, is first crushed by a series of crusher rolls in presence of water. After crushing, the mass is fed continuously with additional



One-man-operated, four-row cultivator.

water to a tube mill or mills. These mills contain flint pebbles and revolve slowly on a horizontal axis. Their action on the shrub depends on the rolling motion of the pebbles in presence of water and results in a further disintegration of the fiber, etc., of the shrub and the agglomeration, or "worming," of the rubber substance into small, round, spongy particles, which vary in size with the condition of the shrub and the time of milling. The fine particles of rubber, or worms, being lighter than water, float on the surface of the discharge liquor from these tube mills, while the bulk of the fiber and other impurities sinks and can be readily separated. The rubber worms, which rise to the surface of the settling tanks into which the liquor from the tube mills is run, are skimmed off and collected. They still contain a large quantity of cork, but are readily separated therefrom by an ingenious process in which the mass is subjected to an hydraulic pressure of 200 to 300 pounds, usually while steam-heated, thereby water-logging the particles of cork and causing them to sink. The mass of small individual rubber worms is then well agitated with plenty of fresh water in a beater washer and discharged into open tanks to settle. In this way a product is obtained practically free from cork particles. The worms so purified are then worked into sheets on sheeter rolls, well washed and dried.

The process as carried out today is practically continuous from start to finish and, with few exceptions, entirely mechanical. The separation of the rubber in the plant is effected with surprising efficiency and completeness. A good average shrub, in prime condition, will yield by present methods as much as 14 to 16 per cent of rubber by weight on a bone-dry basis, this rubber containing on the average about 22 per cent of acetone-soluble substance with traces of ethereal oils, nitrogen, and some insoluble matter.

It is claimed for guayule that it will yield a much higher percentage of rubber per dead weight of shrub than its tropical rival, the hevea tree; also, that its growth and treatment under the present scientific process involve infinitely less expenditure of man power. The tree rubber of the Far East is produced under a system in which the daily work of one man for a year results in the production of 1600 pounds of rubber, whereas in the present stage of culture, with

the special machinery developed by the Intercontinental Company, with the possibilities of improvement, the work of one man on a guayule plantation for a year will account for 25,000 pounds of rubber.

In 1925 a complete experimental station was established in its present location. Mr. J. M. Williams, the resident manager, controls 2300 acres under commercial cultivation of which 1200 acres belong to the company and 1100 acres are leased property. Every possible test of growing conditions is being made. There is a small tract laid out to shrubs grown from unimproved seed imported from Mexico, and an inspection of these shows very strikingly that they lack the uniformity of size and form that is noticeable in the improved California-grown shrub. The guayule is hardy. It favors a light, sandy soil such as is to be found in the Salinas valley region and not only has a highly developed capacity to withstand drought but has the further advantage of not being attacked by any known insect pest or disease. The comparatively low rainfall in that section, therefore, is no detriment to its development. However, the station is testing this out by having one tract under irrigation while the rest is left to depend on natural rainfall. The final results of the more than 16 years of experimental work will be proven in 1931, when there will be a harvest of an 800-acre tract of California-grown shrubs.

Having proven the practicability of growing guayule from the agriculturist's standpoint, the Intercontinental Rubber Company expects to confine its attention in the future to the extraction and manufacture of rubber from the plant. Mr. George H. Carnahan, president of the company, says:

"As eventually to be developed in the United States, guayule growing will be in the hands of the individual farmer or land owner, who will contract his crop and be guided and financed by the factory organization in his vicinity much in the same fashion as the beet-sugar business is conducted."

"Pacific Service" at the present time supplies electricity for running the test mills at the station, where the rubber-extraction process is carried on for experimental purposes, and irrigation of the nursery crops. When the station becomes a commercial institution and factories are established there will be need of a very great deal more of the precious energy.

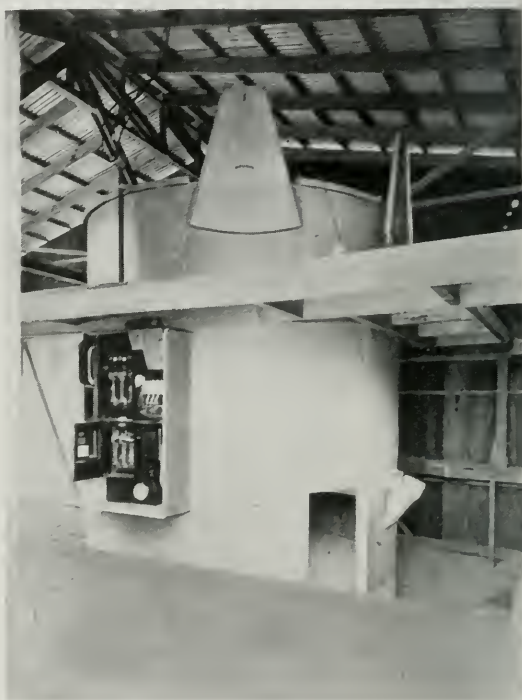
The Walnut in Northern Valleys— Dehydrating by Electric Process

By W. W. SHUHAW, Assistant Manager North Bay Division

The English walnut areas of California have been pretty well confined, in the past, to the southern half of the State. In recent years, however, many of the old southern orchards have become non-productive or have been grubbed out to make way for new cities and homes. A new and thriving walnut industry has been developed in the northern valleys and new walnut areas have been proven. San Joaquin, Alameda, Contra Costa, Sonoma, Lake and other northern counties now boast large walnut acreages and the geographic walnut center is slowly shifting northward.

While these new orchards were small few nuts were produced and no special drying methods were necessary. Many of these trees are now approaching maturity, however, and some means of drying the nuts must be adopted. Mr. Morris of Kenwood, Sonoma County, has solved this problem in a very interesting and businesslike manner by installing an electrically heated walnut dehydrator on his farm. Since this is probably the first electric walnut dehydrator north of San Jose or Stockton, a description of the installation and a few words on drying methods in general may prove of interest.

Walnuts, while on trees, are covered by a hull or burr which remains green and wet throughout the summer and most of the fall. This hull does not split open in this section until about October 15th, at which time the nuts begin to fall. Some of the nuts fall out of the hull, but most of them fall with the covering still on them. If they are allowed to lie on the ground with this wet covering on them for more than a few hours they may be spoiled. To avoid this condition the nuts are usually picked up daily or



The Electric Walnut Dehydrator installed at Mr. Morris' farm.

the trees are beaten with long clubs until all the nuts have fallen and they are then gathered at one picking. They are hauled to the drying shed, the hulls removed and the nuts dried to a moisture content of not more than 10 per cent. A greater moisture content than this may cause moulding or spoiling. The water must not be forced out too rapidly or too slowly and the temperature must not exceed 110° F. during the drying process.

There are three methods in general use by which this excess moisture is removed, namely, drying in the sun on trays in drying yard, the natural draft process, with or

without artificial heat, and the dehydrator method. The last process only will be explained here because it has very definite and outstanding advantages and because its use is spreading rapidly. Approximately fifty per cent of the nuts grown in California will be dehydrated this year.

In drying walnuts by this process they are first hulled and then dumped in bins or spread on trays which are placed in compartments. A heated current of air is then forced through the bins or compartments until the proper amount of water has been driven off. The temperature of this circulating air is subject to automatic control and the relative humidity may be controlled by manually operated dampers. In some instances the air flow is reversible. The advantages of the dehydration process are:

Labor costs much less than sun drying and somewhat less than natural draft method; danger from fogs and rain is eliminated; quality of the nut is improved, since moulding, splitting, etc., are avoided; no dry yard is required, allowing a valuable product to be planted there; the drying time of the nut is greatly reduced, thus tying up equipment and labor for a much shorter period of the year; the nuts are ready for the holiday season, thereby bringing a premium to the grower.

The advantages of electricity for dehydrators are: The absence of an open flame in or near a farm building; the absence of fuel storage tanks; the automatic operation of electricity, which makes an attendant unnecessary and assures proper temperatures at all times; the life of the plant probably will be from fifteen to twenty years; the availability of electricity, since it is now used on almost every farm; the convenience and cleanliness of this type of heat; a better quality nut is produced due to better temperature control; it is usually possible to operate an electric dehydrator by the same power service facilities installed for other farm power uses. In such cases very favorable electric rates are available.

The dehydrator installed at Mr. Morris's



Building which houses the dehydrator.

farm consists of a tight galvanized-iron cylinder sitting on end on a cement base and covered by tight-sitting lids. Within this outer shell are two screen cylinders, one within the other, also sitting on end. The space between them is divided into nut-bins or compartments by radial partitions. Within the center hollow cylinder, which is about three feet in diameter, the motor and fan and heating elements are installed, the fan directing its blast downward. The air flow passing down through the heating elements is deflected across the concrete base and passes up between the outer shell and the larger screen cylinder. It then is drawn through the nuts in a horizontal direction to the hollow center space and passed down again through the fan. The temperature of the air within the dehydrator is controlled by a thermostat switch placed on the concrete floor just below the heating elements. The relative humidity of the air is controlled by manually operated air dampers. The air flow through the nuts is not reversible.

The dehydrator is a 2½-ton capacity machine with 18 kilowatts of electric strip heaters for heating the air and a 3-horsepower motor for driving the fan. Because of the size of the load it is wired 3-phase and operates at 230 volts. This installation can be looked upon as only another indication of the necessity of the use of modern machinery and methods if the farm is to pay its way and succeed. Electricity is thus doing its part to make farming both profitable and pleasant.

The Financial Side of "Pacific Service"

Following is a preliminary statement, in comparative form, of the Company's earnings for the first three-quarters of 1928:

	9 MOS. TO SEPT. 30, 1928	INCREASE
Gross Revenue (including Miscellaneous Income).....	\$45,952,077	\$2,785,575
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals and Reserves for Casualties and Uncollectible Accounts.....	23,280,685	435,188
Total Net Income.....	\$22,671,392	\$2,350,387
Bond Interest and Discount.....	8,033,001	39,098*
Balance	\$14,638,391	\$2,389,485
Reserve for Depreciation.....	4,497,535	628,360
Surplus	\$10,140,856	\$1,761,125
Dividends Accrued on Preferred Stock (6%).....	3,515,680	240,375
Balance	\$ 6,625,176	\$1,520,750
Dividends Accrued on Common Stock (8%).....	4,128,401	527,554
Balance	\$ 2,496,775	\$ 993,196

*Decrease

In the nine months ended September 30th, 1928, the Company's gross business amounted to \$45,952,077, exceeding by \$2,785,575 the corresponding period last year. Approximately \$1,785,000 of this increase represented the operating revenues during the first four months of 1928 of the additional properties acquired on May 1st, 1927, which were not reflected in our earnings prior to that date; the income from these properties being therefore included during the full nine months' period this year, as against but five months in the comparative period of 1927. On the other hand, rate reductions aggregating approximately \$2,300,000 annually were effective during the greater part of the current year, the major portion of such reductions taking effect on March 1, 1928.

In the third quarter of the current year, when the Company's revenues were on a comparable basis as regards the properties operated, gross exceeded the same period of 1927 by \$512,537. This gain in revenue, in the face of lower average rates representing a saving to our customers of approximately \$580,000 during the quarter, indicates that the new schedules are meeting with a satisfactory customer-response. This is particularly noticeable in the field of outdoor lighting and commercial and domestic usage, where the stimulus to consumption afforded by substantially lower rates and a vigorous sales campaign is reflected in an increase during the nine months' period of 16% in kilowatt-hour sales of electricity for street lighting, 23% for heating and cooking, and 10% for commercial and residential lighting purposes. As upwards of 17,000 of the 25,450 additional consumers' meters placed in service during this period were added in the third quarter of the year, a continued growth of sales during the fourth quarter appears reasonably assured. It is also quite probable that the last quarter of the year will witness the placing on our lines of the millionth active meter, the number of customers of all classes receiving service from the Company at the close of September, 1928, aggregating 993,167.

Earnings per share of common stock in the first three-quarters of the year were at the rate of \$2.41 per share of \$25 par value, compared with \$2.13 per share in the same period of 1927. These figures are based on the average amount of common outstanding during the respective periods. At September 30th, 1928, 2,882,674 shares were outstanding or subscribed for, the balance of \$6,625,176 available for common dividends in the nine months ended on that date being equivalent to \$2.30 per share upon this entire amount of common stock.

COMPANY HAS OVER FIFTY THOUSAND STOCKHOLDERS

WOMEN STOCKHOLDERS OUTNUMBER MEN

The Company has recently made an analysis of its stockholders' lists, which affords one or two rather interesting sidelights on the trend of modern stock ownership.

The tendency on the part of women to participate in an increasing degree in the ownership of securities is emphasized by the fact that we have now more women stockholders than men—21,484 of the former and 21,002 of the latter. As recently as three years ago the men stockholders on our registers outnumbered the women by approximately three thousand. In that short space of time the number of women stockholders increased 39 per cent, compared with an increase of only 14 per cent in the number of men. Judging by our own experience, preferred stocks appear to be particularly attractive to the fair sex, our preferred shares being held by 13,513 women and 11,824 men. In addition, the Company's preferred and common stocks are held by 7,680 "joint tenants," usually husband and wife, and by 1,005 insurance companies, associations, estates and similar institutions, there being at June 30, 1928, 51,171 names on our stockholders' registers. This represents the addition of upwards of 5,000 stockholders in the past six months.

The theory that stocks of reputable companies attract a larger following when issued in relatively small denominations receives support in the wider distribution which followed the reduction in the par value of our stock from \$100 to \$25. The number of our common stockholders increased from 13,425 at the beginning of 1927, when the split-up was made, to 19,664 eighteen months later, although no public offering of common stock was made during that interval. There were, however, two offerings of rights to existing common stockholders in this period, which were doubtless responsible for some increase in the number of holders through the purchase and exercise of "Rights" by non-stockholders. The increased distribution was particularly noticeable among the smaller investors. For example, just before the split-up of our stock there were only 867 common holders owning a single \$100 share, while at the present time there are 2,179 holders of from one to four \$25 shares of common.

That the investor of modest resources does not confine himself to preferred shares is also evidenced by the fact that while 11.1 per cent of the holders of common stock own not to exceed \$100 par value, only 7.7 per cent of our preferred stockholders fall within this category.

Approximately four-fifths of all of our stockholders own lots of from one to one hundred shares of stock, the following summary showing the distribution of ownership according to the size of holdings:

Holders of:	NO. OF STOCKHOLDERS	PER CENT OF TOTAL
1 to 5 Shares (\$25 par).....	4,994	9.8%
6 to 10 " ".....	4,621	9.0%
11 to 100 " ".....	30,795	60.2%
101 to 1000 " ".....	10,227	20.0%
Over 1000 " ".....	534	1.0%
Total.....	51,171	100.0%

Stockholders of the Company residing in California number 41,914, or 82 per cent of the total.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII OCTOBER, 1928 No. 6

In these days of wholesale political muckraking, with particular reference to the never-ending campaign of insult and abuse directed against the so-called privately owned public utilities of the country by government ownership theorists and professional political agitators, it is refreshing to be in a position to call the attention of our readers to some very direct expressions of opinion contained in a letter recently published in the *Chicago Tribune* from John Spargo, former Socialist leader and world-famous publicist.

For the benefit of those of our readers who are not acquainted with the life and works of this prolific writer upon public matters we give the following outline: He was born in Cornwall, England, in 1876, and was educated in the public schools, taking Oxford and Cambridge University extension courses. He became identified with the Socialist cause in England at eighteen years of age, and was loud-voiced in his opposition to the Boer War, which started in 1898. He came to the United States in 1901 and at once became active as a leader, writer and worker, particularly in support of the cause of Socialism. He was a delegate from the United States to the International Socialist and Trade Union Congress held at Copenhagen in 1910. He served for several years on the national executive committee of the Socialist party and was a delegate to all its leading conventions. He resigned from the party in 1917 and in September of that year, in collaboration with the late Samuel Gompers, founded the American Alliance for Labor and Democracy. In the following year he was active in founding the National Party, serving as its temporary chairman. In 1919 he was appointed by President Wilson a

member of the Industrial Conference. He was one of the founders of the Prospect House Social Settlement, in Yonkers, New York, and identified himself with a number of philanthropic societies. He is the author of a large number of works, mostly on Socialism. In 1909 he published a life of Karl Marx which has been translated into various languages. In 1920 he published a work entitled "The Greatest Failure in All History, Bolshevism." Among other things, he is an authority on American ceramics.

Writing from his home at Bennington, Vermont, under date of August 28 last, Mr. Spargo congratulated the *Chicago Tribune* upon its fearless stand against the demagoguery which characterizes the unfair and dishonest attacks upon public utilities through propaganda by which, as Mr. Spargo expressed it, "they seek to undermine confidence in the public utility corporations and to stampede the nation into public ownership via the bankruptcy of those corporations which have won for our public utility services the admiration and envy of every nation." Mr. Spargo vigorously defended the action of the public utilities of the country in meeting insidious attack by a campaign of straightforward publicity in which they lay their cards on the table, so to speak, and invite the public of the country to learn the facts and judge for themselves. We quote from the letter as published:

"Much has been made of the fact that the publicity agencies of some of the light and power companies have supplied data which have been incorporated in certain school textbooks, and have supplied other and similar material for use in college lecture courses and the like. I have read the charges made and the replies by representatives of the light and power companies so far as these have been published in the press. It appears to be the fact that none of the matter published in the school texts of which complaint is thus made can be fairly described as 'propaganda.' So far as I can learn, it does not consist of arguments in favor of private or corporate ownership as against government ownership but altogether of factual material, such as popular technical descriptions of processes, historical accounts of the development of light and power services, statistical measures of growth and progress and the like. In no case, so far as I can learn, has there been any such use of arguments favoring private ownership or opposing public ownership as might

be regarded as likely to shape the opinions of pupils upon that great issue. Upon what grounds are we to fear or attempt to exclude from our school texts material of this character? Surely every American child has a right to know, and ought to be taught, the inspiring story of that genius for invention and organization which has given us the cheapest and most efficient electric service in the world.

"But let us assume that it were otherwise, that the public utility corporations had gone much further than they have gone and had successfully taken into the educational system of the country, through inspired material published in textbooks and used in lectures, the case for private ownership and individual enterprise as against public ownership and the discredited theory of Socialism. Is it seriously held by anybody that the propagation of public ownership theories and the condemnation of private ownership is a legitimate and proper use of our school and college facilities, but that to use these for the advocacy of the opposite view is improper, a thing to be condemned and legislated against? By what right of constitution, statute or moral law do the proponents of public ownership assert this monopoly? May not a poor perplexed American citizen ask to be informed as to the source of the privileged position of the advocates of social changes so sweeping?

"I know, and every well-informed student in America knows, that for many years public ownership and Socialism have been preached in American colleges, academies and high schools by the paid lecturers of organizations maintained for the special purpose. This was true many years before any public utilities' publicity bureau in this country ever made the least effort to reach these channels. These paid lecturers did not aim to present objective facts; they did not make the slightest pretense that they were aiming at anything other than converting the students to Socialism, to belief in public ownership and all the economic and social changes that belief implies.

"I can speak with very definite knowledge and authority upon this matter, for I, myself, during several years, was one of the lecturers of the Intercollegiate Socialist Society, later to be transformed into the League for Industrial Democracy. My salary came from the society, furnished by a few men and women who believed that Socialism could be best advanced through

the schools and colleges. During the years I was so engaged I went into every section of this country, appearing in most of the colleges and numerous high schools. Now, I am not befouling the nest in which I was nestled. I am not today a Socialist. For reasons which seem to me incontrovertible, I long since acknowledged Socialism to be unsound in both theory and practice. But here and now what I am concerned with is this very simple question: If it was right for me to present the Socialist view, was it not equally right that the opposite view should be presented? And, if public ownership may be preached in colleges and schools by spokesmen for the Public Ownership League or any other organization, why may not the managers of our public utilities, which would be wrecked as investments if not as services, but probably as both, by the triumph of public ownership, have equal chance to present their case through the same channels?

"It is not only by means of lectures that the Intercollegiate Socialist Society, the League for Industrial Democracy and the Public Ownership League have long used the schools and colleges of the country as a field for their propaganda. They, too, have supplied materials for texts for lectures and debates. Perhaps this is all wrong and no propagandist activity of any kind should be permitted in this important field. But by all that is decent and just, why condemn the public utilities, when it is well known that they were practically compelled to adopt the course they did as a defensive measure, to counteract the systematic attack upon themselves and the social structure of which they are part?

"It was high time that some great newspaper exposed this propaganda and particularly the campaign of abuse and insult which has intimidated and silenced so many of our public men. Every man who has thus far dared to raise his voice against this sort of political muckraking and in defense of American industry has been thus assailed. I have been personally so accused, despite the fact that I have never received a single dollar, or any portion thereof, from any utility corporation, or its agents, directly or indirectly, either for services rendered, support given or for any other purpose whatsoever. But for many years I did receive pay for speaking in favor of public ownership for organizations maintained for that purpose."

Mr. Charles H. Dickey, a member of our company's board of directors, was elected president of the Pacific Coast Gas Association at the annual convention of the association held at Coronado in September.

Mr. Dickey has been identified with the gas business the greater part of his life. For twenty years he was a director of the Consolidated Gas and Electric Company of Baltimore and was also at one time vice-president and director of the Kings County Gas Company of Brooklyn, New York. At the present time he is vice-president and director of the Southern Counties Gas Company of Los Angeles and a director of the Pacific Lighting Corporation. In August, last year, following the election of Mr. A. F. Hockenbeamer to succeed the late Mr. W. E. Creed as president of our company, Mr. Dickey was elected to take Mr. Creed's place upon the directorate.

"It is only recently that the gas industry has awakened to its opportunities," writes Mr. Roger Babson, the well-known publicist. "When electricity first came on the scene everyone said that the gas business was doomed. They did not, however, stop to consider that people need more things than light and motors. Industry stepped in with a demand for gas which has outstripped the wildest imagination. New uses were found. Almost all industrial processes require heat at some stage. Gas has filled this demand. We find it used in enameling, burning brick, dry casting, metal cleaning and drying, chemical industries, hotels, etc. In addition to cooking, domestic uses for gas are developing constantly. Among these are gas refrigeration, house-heating, incinerators, water-heating, etc. The problem before the gas industry is the same as the problem before the light and power companies, namely, that of selling their services to the people. That is where the gas business has been weak in the past, but indications now are that it is becoming an aggressive merchandiser. A few years ago there were less than a thousand industrial uses for manufactured gas that were known, but today there are well over 5,000, largely due to the energetic research work of the companies themselves. Both the natural and manufactured gas business have consequently shown remarkable growth."

Mr. Babson believes that a splendid future lies before the public utilities. He says:

"The old mistaken notion that corporate affairs should be closely guarded has given way to the newer conception of full and accurate information. The most progressive public utilities now are not only willing but anxious to give the public the whole story of their financial affairs.

"The industry as a whole is actuated by high ideals of public service."

It is estimated that the manufactured gas industry of the United States, representing nearly 1,000 different companies, will expend in the vicinity of \$2,000,000,000 during the next ten years for extensions and improvements.

This expenditure is made necessary by the great increase in demand for gas in industry and business as well as in the home. While cooking and water-heating in the home still continue to be the main sources of the gas company's income, recent developments in house-heating, refrigeration and incineration make it probable that the capacity of existing plants must be doubled within the next ten years to care for the demand from these sources alone. Then, the use of gas for industrial heating promises to more than double during the next decade.

Gas men believe that this great development will result in many changes in the present methods of manufacturing and distribution. Already the trend is toward the construction of large economical generating plants located at central strategic points, the gas being distributed through high-pressure mains over wide territory in a similar way to that employed in distributing electric energy.

In this latter connection we take occasion to remind our readers that the distribution of gas at high-pressure is no new thing here. As a matter of fact, with "Pacific Service" it goes back as far as 1879, when gas manufactured at the Oakland works was carried upon the mains to the holder in Alameda, this high-pressure system being subsequently extended to include distribution to customers. This was the first installation of its kind in the United States. Of recent years high-pressure has become the systematic policy of our company's Gas Department.

As of December 31, 1927, this company's gas distribution system includes 180 miles of high-pressure transmission mains and 1,701 miles of high-pressure distribution mains.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 987,000 CONSUMERS OF
GAS * ELECTRICITY * WATER * STEAM
 2,515,901 Total Population Served in Thirty-eight of California's Counties
 CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity.....	311	1,750,572	37	164,675	348	1,915,247
Gas.....	84	1,781,375	5	14,702	89	1,796,077
Water (Domestic).....	20	24,100	4	18,500	24	42,600
Railway.....	1	105,000			1	105,000
Steam Heating.....	2	1,003,000			2	1,003,000

Place	Population	Place	Population	Place	Population	Place	Population
Acapulco.....	1,000	Coyote.....	250	Hollister.....	4,500	Newark.....	1,100
Agnew.....	125	Crockett.....	2,500	Honcut.....	500	Newcastle.....	750
Alameda.....	35,140	Crows Land- ing.....	300	Hopland.....	500	Newman.....	1,250
Albany.....	6,000	Daly City.....	6,500	Hughson.....	625	Niles.....	1,850
Alamo.....	100	Danville.....	500	Hydesville.....	200	Nord.....	60
Alleghany.....	300	Davenport.....	500	Inverness.....	215	Notoma.....	200
Alta.....	100	Dayton.....	60	Ione.....	900	Novato.....	1,000
Alton.....	200	Decoto.....	700	Irvington.....	1,200	North Sacra- mento.....	2,500
Alvarado.....	1,120	Del Monte.....	300	Jackson.....	2,500	Oakdale.....	2,000
Alviso.....	640	Denair.....	400	Jamestown.....	1,000	Oakland.....	205,000
Amador City.....	750	Diamond.....	200	Jenny Lind.....	109	Oakley.....	300
Anderson.....	1,180	Dixon.....	1,200	Junction City.....	50	Oceidental.....	600
Angel Island.....	500	Dobbins.....	200	Kelseyville.....	600	Orland.....	155
Antioch.....	2,800	Downtown.....	200	Kenwood.....	20	Orland.....	2,100
Appleton.....	100	Duncan's Mills.....	250	Kewick.....	20	Oroville.....	7,000
Aptos.....	200	Durham.....	600	King City.....	1,603	Pacifica.....	5,000
Arbuckle.....	900	Dutch Flat.....	400	Kingston.....	100	Palo Alto.....	9,550
Arcata.....	2,200	Dunnigan.....	150	Knights Ferry.....	200	Paradise.....	600
Artois.....	200	Eldridge.....	500	Knights Land- ing.....	525	Patterson.....	700
Asti.....	100	El Cerrito.....	3,000	La Fayette.....	300	Pebble Beach.....	300
Atherton.....	800	El Dorado.....	1,450	La Grange.....	200	Penn Grove.....	250
Auburn.....	3,000	Elk Grove.....	1,450	La Jolla.....	1,250	Penryn.....	250
Bangor.....	50	Elmira.....	300	Lafayette.....	1,000	Perkins.....	50
Banta.....	500	El Verano.....	500	Lathrop.....	300	Petaluma.....	7,500
Barber.....	50	Emeryville.....	5,000	Lawndale.....	60	Piedmont.....	9,000
Barlow.....	1,000	Empire.....	250	Lewisville.....	100	Pineole.....	1,000
Belmont.....	1,000	Escalon.....	700	Lincoln.....	2,000	Pittsburg.....	8,500
Belyedre.....	750	Esposito.....	600	Live Oak.....	1,800	Placerville.....	2,250
Benicia.....	2,750	Eureka.....	29,000	Livermore.....	3,600	Pleasanton.....	1,800
Ben Lomond.....	500	Fairfax.....	1,200	Lockeford.....	500	Plymouth.....	400
Berkeley.....	80,000	Fairfield.....	1,200	Lodi.....	5,000	Point Reyes.....	310
Bethany.....	50	Fair Oaks.....	500	Loleta.....	800	Port Costa.....	950
Bigness.....	750	Farmington.....	300	Lomita Park.....	1,325	Potter Valley.....	600
Big Oak Flat.....	150	Felton.....	300	Lomita.....	500	Princeton.....	200
Blue Lake.....	500	Ferndale.....	1,500	Los Altos.....	1,800	Red Bluff.....	2,500
Bolinas.....	400	Field's Land- ing.....	200	Los Gatos.....	4,750	Redding.....	5,000
Boyes Springs.....	1,000	Finley.....	100	Los Molinos.....	450	Redwood City.....	8,000
Brentwood.....	500	Florin.....	1,400	Lytton.....	100	Richmond.....	28,700
Browns Valley.....	125	Folsom City.....	1,500	Madison.....	300	Rialva.....	500
Burlingame.....	13,150	Forest City.....	300	Magalia.....	100	Rio Dell.....	600
Burney.....	75	Forestville.....	200	Manteca.....	2,000	Rio Nido.....	250
Butte City.....	200	Fortuna.....	1,200	Manton.....	65	Rio Vista.....	1,100
Byron.....	400	French Camp.....	200	Mare Island.....	600	Ripon.....	1,000
Calistoga.....	1,000	French Gulch.....	170	Martell.....	100	Riverbank.....	1,200
Camino.....	300	Fresno.....	72,000	Martinez.....	7,000	Rocklin.....	700
Campbell.....	1,500	Galt.....	1,000	Maxwell.....	8,500	Rodero.....	900
Camp Meeker.....	300	Georgetown.....	300	McArthur.....	167	Roseville.....	7,000
Cana.....	300	Gerber.....	400	Merced Park.....	3,500	Ross.....	900
Capitola.....	450	Geyersville.....	750	Meridian.....	250	Sacramento.....	105,000
Carlotta.....	75	Gilroy.....	3,700	Middletown.....	580	Salida.....	300
Carmel.....	2,500	Glen Ellen.....	1,200	Millbrae.....	350	Salinas.....	6,500
Carmel High- lands.....	300	Glen Rm.....	50	Mills.....	50	San Andreas.....	600
Castroville.....	400	Gonzales.....	500	Mill Valley.....	3,500	San Anselmo.....	4,500
Cement.....	1,000	Graton.....	250	Millville.....	200	San Ardo.....	300
Centerville.....	1,775	Grass Valley.....	6,000	Milpitas.....	400	San Bruno.....	2,175
Ceres.....	1,100	Greenfield.....	350	Mission San Jose.....	500	San Carlos.....	1,200
Chico.....	12,000	Gridley.....	2,500	Modesto.....	17,000	San Francisco.....	708,000
Chico Viejo.....	2,500	Grimes.....	500	Mokelumne.....	237	San Jose.....	68,000
Chester.....	300	Groveland.....	250	Hill.....	237	San Juan.....	500
Clements.....	200	Guerneville.....	1,200	Monterey.....	6,900	San Leandro.....	12,000
Cloverdale.....	1,000	Hamilton City.....	300	Monte Rio.....	500	San Lorenzo.....	1,000
Colfax.....	800	Hammonton.....	500	Morgan Hill.....	1,200	San Lucas.....	300
College City.....	250	Hayward.....	5,000	Mountain View.....	3,000	San Mateo.....	11,500
Collinsville.....	300	Healdsburg.....	3,000	Napa.....	7,000	San Pablo.....	1,500
Colma.....	2,900	Hercules.....	600	Nelson.....	50	San Quentin.....	3,500
Columbia.....	400	Hickman.....	40	Nevada City.....	1,800	San Rafael.....	7,800
Columbia.....	2,200	Hillsborough.....	1,000			Santa Clara.....	6,500
Concord.....	4,200					Santa Cruz.....	17,500
Copperopolis.....	300					Santa Rita.....	150
Corcoran.....	350					Santa Rosa.....	14,000
Corning.....	1,800						
Corte Madera.....	1,000						
Cotati.....	600						
Cottonwood.....	704						

Unmarked—Electricity only.

1—Gas only.

2—Gas and Electricity.

3—Gas, Electricity and Water.

4—Gas, Elect. and St. Railways

5—Electricity and Water.

6—Electricity supplied through other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.

Total Cities
and towns.....2,031,887
 Add San Fran-
 cisco.....600
 Population.....484,014
 Total Popula-
 tion Served.....2,515,901



*Pacific Gas and Electric Company's
General Office Building, San Francisco*

It Would Take a Hundred Buildings Like This

to accommodate the

Hundred Thousand
Investors

in the

BONDS AND STOCKS

of the

Pacific Gas and Electric Company

Every one of these numerous holders
of this Company's securities is
receiving a regular income
from his investment.

The Company's FIRST AND REFUNDING MORTGAGE BONDS FIRST PREFERRED STOCK COMMON STOCK

afford desirable mediums of investment in one of the largest and
soundest of the nation's public service institutions, which, with its
predecessors in title, has a record of three-quarters of a century of
successful operation.

RECORD OF RECENT GROWTH

	Gross Operating Revenue	Number of Customers	Sales of Electricity (K.W.H.)	Sales of Gas (Cu. Ft.)
1923.....	\$39,321,535	710,034	1,199,063,000	13,674,794,000
1924.....	44,451,586	763,617	1,334,035,000	15,277,478,000
1925.....	47,729,079	813,698	1,351,798,000	16,200,951,000
1926.....	50,960,571	874,724	1,514,981,000	17,482,206,000
1927.....	54,719,227	967,717	1,657,965,000	20,214,834,000
1928 (12 mos. to June 30)	60,196,255	976,025	1,718,842,000	20,378,048,000

Pacific Gas and Electric Company

245 Market Street, San Francisco

PACIFIC SERVICE MAGAZINE



MANZANITA LAKE
MT. LASSEN IN THE BACKGROUND
PACIFIC SERVICE TERRITORY

Vol
17

JANUARY 1929

No
7

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.....	Berkeley
.....	Fresno
.....	Eureka
.....	San Rafael
.....	Petaluma
.....	Napa
.....	Vallejo
.....	Santa Rosa
.....	Sacramento
.....	Dixon
.....	Vacaville
.....	Woodland
.....	San Francisco
.....	Stockton
.....	Jackson
.....	Sonora
.....	San Jose
.....	Redwood City
.....	Red Bluff
.....	Redding
.....	Red Bluff

Pacific Service Magazine

Volume XVII

Number 7

Contents for January, 1929



PLAN OF NATURAL GAS PROJECT	Frontispiece
NATURAL GAS FOR BAY CONSUMERS— GIANT PROJECT ALREADY UNDER WAY	W. S. Yard 203
THE TRAIL OF "PACIFIC SERVICE" THROUGH THE LAND OF THE PADRES	J. P. Jollyman 210
"PACIFIC SERVICE" AND THE FARMER— LETTUCE INDUSTRY IN SALINAS VALLEY	Jas. F. Pollard 214
HEADQUARTERS FOR DRUM DIVISION WORTHY OF ITS GROWING IMPORTANCE	219
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 224
EDITORIAL	226
IN MEMORIAM	232

Natural Gas for Bay Consumers— Giant Project Already Under Way

By WILLIS S. YARD, Vice-President in Charge of
Gas Construction and Operation

Natural gas will be available to consumers in the San Francisco Bay area by the middle of August of the present year.

Our company has negotiated a contract for laying the first section of a giant pipe line which will bring the gas from the San Joaquin Valley oil fields to San Francisco, Oakland, San Jose and adjoining territory.

The main pipe line will be 250 miles long. Pipe for the first 60 miles has already been manufactured by the A. O. Smith Corporation in Milwaukee and is being dispatched to California in trainloads carried at express speed. At the time of writing the first trainload of 86 cars, carrying 14.6 miles of 20-inch pipe, has already arrived, and work on the first section is under way.

Plans for the pipe line call for a 16-inch main from the Buttonwillow gas field, near Taft in Kern County, to Kettleman Hills, California's latest and perhaps largest gas field. From Kettleman the line will be 22 inches in diameter to Mendota, in Fresno County; there it will reduce to 20 inches and will turn west through Panoche Pass to Tres Pinos and run by way of Hollister, Gilroy and San Jose to Milpitas.

At Milpitas a metering station will be established from which two branches will take off, one to San Francisco and the other to Oakland, Alameda, Berkeley and Richmond.

The entire line will be welded throughout and will form practically a continuous tube without joints from the oil fields to the Bay area, making leakage almost impossible. The pipe for the branch from Milpitas to Oakland will be manufactured at the plant of the Western Pipe and Steel Company in South San Francisco.

Fresno will be supplied through an 8-inch branch which will leave the main line at Huron and run 40 miles across the floor of the San Joaquin Valley. Including this branch and the branch from Milpitas to Oakland, the total amount of pipe to be laid will be 282 miles and will fill more than 1800 cars or 30 trains of 60 cars each.

A new gas holder of 10,000,000 cubic feet capacity will be erected in San Francisco and one of 8,000,000 cubic feet in Oakland, increasing storage facilities in the two cities to more than 60 million cubic feet.

Gas will be delivered to the pipe line in the Buttonwillow and Kettleman fields at a pressure of 400 pounds. This pressure will be reduced en route so that the gas will arrive in San Francisco and Oakland at a pressure of 50 pounds. Long-term contracts already made assure an ample supply of gas for a term of years. It is expected that use will increase rapidly. As soon as the demand warrants a large compressor plant will be erected near Kettleman Hills to add to the supply. Later a booster station will be constructed between Kettleman Hills and San Jose, which will give the line an ultimate capacity of at least 125,000,000 cubic feet per day.

This is truly a giant project and represents a contemplated expenditure of, in round numbers, \$13,000,000. That our company's management considers it eminently worth while is evidenced by the following statement to the public issued by President A. F. Hockenbeamer:

"This undertaking will prove the greatest contribution of this generation to the growth and development of the Bay area. Natural gas is a cheap and efficient fuel which will

not only attract new industries but keep old ones here. Only today we learned that a large factory in Oakland, a branch of a nation-wide corporation, was considering removing to Southern California in order to have the advantage of natural gas for fuel. Our assurance that natural gas would be here in August changed the plan. The factory will remain in Oakland.

"Natural gas is not only a cheap fuel but it is adaptable and convenient. Industries can use it with a minimum of labor. In our own case we expect to use large amounts in our steam electric generating stations in San Francisco and Oakland, including the large new steam plant about to be constructed in San Francisco.

"While household consumers will be served a mixture of natural and artificial gas, large industries located close to the pipe lines which will pass through the principal industrial areas will be supplied with straight natural gas. Unusually low rates will be available to industries that can use gas at night and between times when there is not a great demand for household purposes, like heating and cooking. They will be able to get what we call an off-peak rate. Industry of all kinds should be greatly stimulated by this rate and this service. In fact, nothing better has been done to stimulate industrial growth since the nineties, when large blocks of hydro-electric power were brought into the Bay area.

"Domestic consumers will also profit.

Natural gas has greater heating value than artificial gas, and the mixed gas we propose to serve to domestic consumers will contain 700 heating units as against 550 carried by the artificial gas now being distributed. With increased heating values and with rate adjustments we propose to make, consumers in the Bay area will save \$3,000,000 a year in their gas bills."

Gas service was first established in San Francisco in 1854. At that time it was used only for lighting purposes and sold for sixteen dollars per thousand cubic feet. For seventy-five years those responsible for the gas supply in the western metropolis have planned and constructed to improve and reduce the cost of gas service in order that the uses of gas might be extended and the industry grow and prosper. Many changes in gas manufacturing processes have been made. Coal was the first fuel used for gas production, then a combination of coal and oil; finally, a process was developed about 1905 for producing gas from crude oil and from that time to the present the gas supplied to consumers in the San Francisco Bay area has been manufactured from oil.

Natural gas is no new commodity to California. As far back as the '60's natural gas was distributed to the people of Stockton from a plant located in that city. The city of Sacramento, too, has had natural gas since early days. But, it was not until comparatively recent years that the activities of the Southern California oil fields, particu-



First train arriving at Roseville from Milwaukee with pipe for the main line. Eighty-six cars, carrying 14.6 miles of 20-inch pipe.

larly in Ventura and Kern Counties, began to liberate natural gas in enormous quantities that the practicability of conserving this and, at the same time, turning it to commercial account, involving its transportation over long distances to the large centers of population in the state, engaged the earnest attention of gas engineers.



Close-up view of pipe aboard train from Milwaukee.

About a year ago Governor C. C. Young, acting upon reports that natural gas was being wasted in the oil fields at the rate of nearly 100,000,000 cubic feet per day, appointed a Commission to examine into the gas wastage problem and to devise, if possible, a feasible plan for its conservation and economical utilization. While this Commission has studied the situation from its various angles, private enterprise has lent its co-operation to the extent of solving the major problems involved of transmitting natural gas over long distances in virtually unlimited quantities.

"Pacific Service" has not been blind to the

situation. For many years our company has tried to find a natural gas supply available to the Bay area in order to stimulate industrial development in that section. In 1920, a well was drilled to a depth of 5000 feet in Solano County in an area which gave promise of being a large potential gas structure. Gas was not found in commercial quantities, however, so the company decided to do no more drilling but to follow all oil and gas developments north of Bakersfield in the hope of some new gas fields being found near enough to the Bay area to permit the transmission of natural gas to that locality at a cost which would be attractive to



A quantity of 20-inch pipe on the ground near Martin sub-station, San Francisco. This is for the branch line from Milpitas.

large industries.

About two years ago, a new gas field was discovered in the area known as Buttonwillow, about thirty-five miles west of Bakersfield and two hundred and forty-seven miles from San Francisco. A number of gas wells were completed showing more than a thousand pounds pressure and each well capable of delivering five to ten million cubic feet of gas per day. A test well about fifty-five miles northwest of Buttonwillow, in the location known as Kettleman Hills, showed very high gas pressures, as did other wells in the San Joaquin Valley. About a year ago estimates were prepared and preliminary surveys and studies made for the location of pipe line and gas available for transporting to San Francisco and Oakland. These investigations were carried on until a satisfactory plan had been developed and a sufficient gas supply assured. Surveyors and right-of-way men were placed in the field, six miles of twenty-inch pipe was ordered the first week in December last and two weeks later this pipe was being laid in the new Bay Shore highway from the Potrero Gas Works, south towards South San Francisco.

Early in January this year orders were placed for a total of two hundred and eighty-two miles of steel pipe to be laid from Buttonwillow to San Francisco and Oakland.



Five miles of 20-inch pipe. Pipe on the left wrapped for protection against soil corrosion, pipe on the right being painted preparatory to wrapping.

This represents a consignment of 41,000 tons of pipe for the main line and, as it is being shipped by rail, it will take 1,652 carloads to deliver the entire order. On January 28th, the following telegram was received from the A. O. Smith Corporation in Milwaukee:

"Pacific Gas and Electric Company — One hundred thirty-two cars of pipe consisting of two solid trainloads of sixty-six cars each with double-header engines left this morning at one and one thirty A. M. Additional trainload leaving today at noon. California here we come. Best regards."

Immediately upon receipt of this wire, a contract was let for the Panoche Hills section; the pipe was received February 4th, and construction of the pipe line is proceeding south from Tres Pinos. At the same time, the pipe crew from San Francisco is nearing South San Francisco, and by the first of March actual construction work will be well under way between Kettleman Hills and San Francisco and Oakland. The present plans call for completion of the project

by August first and, unless some unforeseen contingencies arise, natural gas will be available in the Bay area before August 15.

The main transmission line will start at the gas wells in the Buttonwillow gas field where seven wells have been



View of wrapping machine applying protective covering to 20-inch pipe.

completed and standing ready to deliver gas at 400 pounds pressure as soon as the pipe line is completed. This gas main will be sixteen inches in diameter and extend northwesterly fifty-three miles to a point near the northern end of the Kettleman Hills. At this location, a large compressor plant will be built at a future date. At the present time, cottages, warehouse, laboratory and general pipe line headquarters will be constructed.

The necessary connections will be provided and a twenty-two inch diameter steel main laid northwesterly a distance of forty-one miles to a point southwest of Mendota. There the line will branch into two twenty-inch lines, provision being made at some later date to extend one twenty-inch line to serve points north, but at the present time laying only the twenty-inch line northwesterly through Panoche Pass to Tres Pinos, Hollister, Gilroy, San Jose and terminating at Milpitas, a total distance of two hundred and three miles from Buttonwillow. At Milpitas, metering stations will be installed and a twenty-inch line will be laid northwesterly a distance of forty-four miles to the Potrero Gas Plant in San Francisco. A second twenty-inch line will be laid northeasterly to the Oakland Gas Works at the foot of Market Street, Oakland, a distance of thirty-five miles, making a total of two hundred eighty-two miles of natural gas transmission pipe line.

The pipe will be welded and protected from corrosion by wrapping with a special protective covering or painting as soil conditions may require. A private telephone system for operation will follow the pipe line; cottages and the necessary buildings will be erected for patrol stations, garages, shops, etc.



Potrero Gas Works, San Francisco. A 10,000,000-cubic-foot holder will be erected here to store natural gas.

This system is designed to take gas at Buttonwillow and Kettleman Hills and deliver 65,000,000 cubic feet per day at the terminals. By installing the necessary booster stations, this delivery can be doubled. The cost of this transmission system, including a branch line to Fresno, will approximate \$11,300,000. Other changes made necessary by the introduction of natural gas will require an expenditure of \$1,750,000, making an over-all expenditure for this natural gas project of \$13,000,000. As soon as the twenty-two inch section of the pipe line is completed, an eight-inch lateral line will be laid to Fresno.

The gas being produced in the Buttonwillow field is a dry gas; that is, it contains no gasoline and has a heating value of approximately 1,050 British thermal units per cubic foot. The gas in the Kettleman Hills area contains a large quantity of gasoline and is called a wet gas. It is necessary to remove the gasoline from the natural gas before turning the gas into the pipe line. In order to save the gasoline, the oil producers install absorption plants for removing the gasoline and deliver the natural gas to the pipe line practically free of it. The gas from the Kettleman Hills wells after having the gasoline removed will average between 1,200 and 1,250 British thermal units per cubic foot in heating value.

At the present time, seven gas wells have been completed in the Buttonwillow area, showing well pressures of one thousand and fifty pounds and an estimated daily delivery capacity of thirty to fifty million cubic feet per day if required. In the Kettleman Hills, the Elliott No. 1 well has been producing daily about four thousand barrels of sixty gravity oil and more than forty million cubic feet of gas and maintaining twelve hundred and fifty pounds well pressure for

over ninety days. Plans have been completed for drilling twenty wells in this area, a number of wells are now drilling and by the time the pipe line is completed several should be producing gas and oil. The Kettleman Hills productive oil zone is over seven thousand feet deep, so that six months is the minimum time in which a well completion may be expected. Geologists agree that the Kettleman Hills and adjacent territory represent one of the largest potential gas and oil reserves in California. Other wells being drilled between Buttonwillow and Kettleman Hills, and for considerable distances east, show the presence of large quantities of gas. The large area over which gas has been found in this section makes certain a large supply for many years to come for the Bay area.

The gas supply appearing to be satisfactory and the general transmission system



Oakland Gas Works. An 8,000,000-cubic-foot holder to be erected for natural gas storage.

having been worked out, the next problem to be solved was the kind of gas to be served for general domestic use. The pipe line being 247 miles long and only one main trunk line at this time, made it hazardous to attempt to serve straight natural gas as these pipe lines break at times, although the best of workmanship and materials are used. More than 370,000 gas consumers' service would be interrupted if straight natural gas was supplied and any trouble developed with gas supply or pipe line.

Another serious difficulty to be overcome was the effect of straight natural gas on burners of appliances now being used with manufactured gas of 550 British thermal units. Every appliance would require adjusting and change of orifices in the burners. Many appliances would require new burners and considerable expense would be involved as well as inconvenience to consumers during the change-

over. Many other difficulties are encountered in turning natural gas into a manufactured gas distribution system, such as meter deterioration and increase in leakage due to the action of natural gas on the deposits left by manufactured gas. These deposits are converted into small dust particles and tend to stop up openings in burners and pilot lights.

After considering all these difficulties, it was



Fresno Gas Plant. This city, being near the natural gas fields, will be served straight natural gas.

decided to serve a mixed gas of 700 British thermal units heating value instead of the 550 British thermal unit gas as now served to domestic consumers. Straight natural gas will be supplied only to industries on shut-off contracts, where oil burners can be used for short periods in event of any interruption to the gas supply. When this pipe line is completed, all consumers from San Jose north to San Francisco and Oakland will be served a mixed gas having twenty-seven per cent more heat available than the present gas now being supplied.

When natural gas was first introduced into Santa Barbara, a 700 British thermal unit gas was served and a minimum of trouble and inconvenience to consumers was experienced in changing from the 550 British thermal unit oil gas. The Los Angeles Gas and Electric Company also served a gas of this character for many years before changing to straight natural gas about a year ago. The gas to be distributed will be approximately the same specific gravity as the oil gas now being served and the general characteristics about the same, except that the flame of the new gas will probably be longer and more yellow. The change from 550 to 700 British thermal units will be made gradually by increasing the British thermal units over a period of several days until the 700 British thermal unit gas service is finally established. Specially trained appliance men will be ready to follow the introduction of the new gas and adjustments made where necessary in order that the change-over may be made with the least possible inconvenience to our consumers.

Fresno, being near the natural gas fields, will be served straight natural gas. All appliances will require adjusting and plans are

being made for dividing the city into sections, so that a given area will be converted to natural gas service. Then another section will be converted until finally all the gas consumers in Fresno will be receiving natural gas.

Extensive changes are necessary in the gas-generating plants at Potrero and Oakland in order to produce the new 700 British thermal unit gas. A 10,000,000 cubic foot holder will be erected to store natural gas at the Potrero Works to insure natural gas for mixing and gas manufacturing. Automatically controlled mixing devices will be installed to maintain a gas of uniform heating quality. Total expenditures to make the change-over at the Potrero Plant will amount to \$900,000. An 8,000,000 cubic foot storage holder will be constructed at Gas Station "B," Oakland, the necessary changes in equipment and holder costing \$800,000. No storage holder will be built in San Jose at this time, but changes in plant made necessary by the introduction of natural gas will cost approximately \$50,000.

Service of the 700 British thermal unit mixed gas requires the operation of the generating plants at about half the capacity now operated. Natural gas will be used in the generators in the place of oil now used, the gas manufactured from the natural gas will be mixed with natural gas so that the gas to be served is spoken of as a "mixed gas," the proportions of the two gases will be such as to provide a 700 British thermal unit gas for distribution. The San Jose, Oakland and San Francisco gas plants will operate on a mixed gas basis so that consumers served from these plants will receive the new gas early in August.



The Trail of "Pacific Service" Through the Land of the Padres

By J. P. JOLLYMAN

Chief of the Division of Hydro-Electric and Transmission Engineering

The January, 1928, issue of PACIFIC SERVICE MAGAZINE contained an article descriptive of a new electric transmission and distributing project about to be undertaken by our company in order to extend the high-tension lines of "Pacific Service" to the rapidly growing agricultural region lying south of San Jose, taking in the Salinas Valley and providing improved service throughout newly acquired territory whose southern extremity is at the town of San Ardo.

This project, it was explained at the time, was the natural result of the acquisition by our company, through purchase, of the properties of the Sierra and San Francisco Power Company and the Coast Valleys Gas and Electric Company, constituting a part of the properties acquired from the Byllesby interests in 1927. The original Sierra and San Francisco system maintained a 60,000-volt double-circuit transmission line from its substation at Port Marion, four miles west of Newark, through Morgan Hill and Gilroy to its substation at San Juan Bautista and from that point on to Salinas to a substation in which it shared ownership with the Coast Valleys Gas and Electric Company. In 1920 our company leased the properties of the Sierra and San Francisco Company and some years later built a 110,-

000-volt line from the Sierra and San Francisco Company's main distributing station at Manteca in the San Joaquin valley to Salinas. The Coast Valleys Company maintains transmission lines west and south of Salinas, one running from Salinas to Monterey and Carmel, the other from Salinas to San Ardo, receiving its power at wholesale from the Sierra system. North of Monterey the Coast Counties Gas and Electric Company owns the distributing systems in the lower section of the Santa Clara valley, below San Jose, and in San Benito and Santa Cruz counties. Pacific Gas and Electric Company has for some years wholesaled power to this company for distribution in Santa Clara county by transmission to the latter's substation at Morgan Hill, and in Santa Cruz county through a line from the "Pacific Service" station at Mountain View to its substation at Davenport.

When, however, in 1927 our company acquired complete control of the properties of the Sierra and San Francisco and Coast Valleys Companies, an opportunity was afforded to materially assist in the development of a large territory which is enjoying rapid growth in agricultural and industrial activities. It is a picturesque region, for from San Jose El Camino Real travels



Newark substation. In the right foreground is shown the new 110,000-volt bus structure to accommodate the Newark-Salinas tower line.

through the orchards of lower Santa Clara valley and by way of the historic San Benito and Salinas valleys to Monterey peninsula. Then, the stretch of territory through the Salinas valley as far as San Ardo presents almost limitless possibilities in the way of agricultural development with the aid of cheap and available electric power.

Our company determined upon a plan of service extension which would make it possible not only to provide facilities to take care of the growth of the purchased properties but, also, to improve service to the Coast Counties Gas and Electric Company's system.

It was found that the existing lines would be inadequate for the purpose intended; therefore, a new transmission and distribu-



Three transmission lines leave Newark for points south. The Salinas line is on the left, the San Jose line next, and the Newark-Martin lines on the right.

tion project was decided upon which included the construction of an entirely new double-circuit steel-tower 110,000-volt line from our company's Newark substation through Morgan Hill to Gilroy, a distance of 45 miles, reconstruction of the existing tower line from Gilroy to Lagunita, a distance of eighteen miles, to adapt it for use at 110,000 volts, and the construction of a new 110,000-volt tower line from Lagunita to Salinas, a distance of eight miles. The project included also the construction of a 110,000-volt outdoor substation at Morgan Hill, adjacent to that owned and operated by the Coast Counties Company, and additions in the condenser equipment at Salinas substation to take care of the increased power load.

It will be of interest to our readers to know that excellent progress has been made with this project. The new tower line is completed as far as Morgan Hill, the Morgan Hill substation is at the point of completion, and the additional equipment at Salinas is already in place.

Construction work started in the late spring of last year. The Newark substation was selected as the starting point of the new lines because it was the nearest central distributing point on the "Pacific Service" system. Lines from Stanislaus, Electra, Drum and the Pit River power plants come in at Newark, and interconnections are maintained with the steam plants in San Francisco and Oakland. Newark is, in fact, the main distributing point for the whole system



The line crossing Alum Rock avenue, near San Jose.

south of Oakland, and is to the southern end of the "Pacific Service" chain what Vaca-Dixon is to the northern.

At Newark substation the necessary construction work in connection with the new transmission project includes an extension of the 110,000-volt bus-structure with oil-circuit breakers for the control of the two new circuits to Morgan Hill and Salinas. Including this addition, which has been completed, Newark now controls twelve 110,000-volt incoming or outgoing circuits, the largest number radiating from any substation supplying "Pacific Service."

For the first two miles south of Newark the new line was built adjacent to the Newark-San Jose 110,000-volt tower line and the 60,000-volt lines joining Newark with Martin substation south of San Francisco. The problems encountered in its location and construction were brought about by the highly developed character of the region rather than by any natural obstacles. Property lines were followed where possible to avoid severance. In some places, especially near Berryessa, fruit trees of unusual height were found which required towers



Line crossing orchard region near Evergreen.

of extra height to give additional clearance from the line wires to ground. In this valuable orchard country, the towers are carefully located with reference to the fruit trees so as to obstruct cultivation as little as possible.

Crossings over important highways and railroads required special consideration. The crossing over Alum Rock Avenue, which is the main outlet east from San Jose, presented a problem in location, since the property on either side was divided into small holdings and city lots. Parcels of property were purchased on both sides of this street over which the line was routed. The crossing over the State Highway, four miles north of Morgan Hill, is a good illustration of this problem. Here, in addition to the State Highway, the coast line of the Southern Pacific Railroad had to be crossed as well as our own double-circuit 60,000-volt line, also important telegraph and telephone lines.

While a tower line is built in as near a straight line between terminals as conditions permit, angles must be turned to avoid natural obstacles. A line traversing a highly developed region requires many angles. Special tower construction for light and moderate angles has been developed which permits the use of a single string of insulators for the support of each wire. The



B. H. O. tower near Madrone. This type is used for moderate angles.

concrete footings for the towers were redesigned to permit their installation in a 36-inch diameter hole about six feet deep. Such a hole can be dug in earth with a power-driven hole digger, involving a material saving of labor and expense as compared with a hand-dug hole.

The new line follows the general route of the El Camino Real. It passes three miles to the east of San Jose and thence along the foot of the hills on the east side of the valley to within four miles of the town of Morgan Hill, where it crosses to the west side. From that point it will take a southeasterly direction and pass to the east of Gilroy, where it will join the Sierra line to Salinas. The total distance from Newark to Salinas is about 71 miles.

The new substation at Morgan Hill is, at the time of writing, nearly completed. It will receive power at 110,000 volts from either or both of the 110,000-volt circuits and will "step" the power down to 60,000 volts for distribution through the region which includes Morgan Hill, Gilroy, San Juan and Watsonville. In emergencies power may be fed north toward San Jose, and pending the completion of the Morgan Hill-Salinas 110,000-volt line one year hence, power will be fed to Salinas at 60,000 volts. The transformers have a capacity of 30,000 kilowatts, or 40,000 horsepower; they are the first large transformers employed by "Pacific Service" to be self-cooled. The cooling is assisted by blowers during hot weather or during heavy loads. This substation is of the simplest possible design. All ordinary operation will be automatic.

This station supplies the adjacent Morgan Hill substation of the Coast Counties Gas and Electric Company with power.

Work has been started on the reconstruction of the existing tower line from Gilroy to Lagunita to adapt it for use at 110,000 volts. The two-leg towers, about one-third the total, will be replaced with standard four-leg towers. New conductors will be strung on most of the line and insulators added on the 110,000-volt circuit.

The additions at Salinas substation, installed to meet the increased load in Monterey county and in anticipation of the construction of the Newark-Salinas 110,000-volt line, have been completed. The second 20,000 kv-a 110,000 to 60,000-volt transformer bank and the second 10,000 kv-a synchronous condenser were installed several months ago and rendered valuable assistance in carrying the heavy load of the past summer. The synchronous condensers at Salinas perform an important function in the operation of the electric system. Were it not for these machines, which act as voltage regulators, the changes in the load on the lines supplying this substation would produce fluctuations in voltage which would be difficult to overcome. Furthermore, the synchronous condenser makes it possible to carry more load over the lines than would otherwise be possible.

It is planned to have the Morgan Hill-Salinas section of the new 110,000-volt line completed by the spring of 1930. The southerly part of our system will then have an improved power supply with sufficient spare capacity for several years' growth.



General view of Morgan Hill substations. To the right is the Coast Counties station, to the left the out-door "Pacific Service" station now at point of completion.

“Pacific Service” and the Farmer— Lettuce Industry in Salinas Valley

By JAS. F. POLLARD, *Manager Coast Valleys Division*

Making his way on foot beside his patient, straining ox-team in the days before the gold rush, a sturdy pioneer painfully toiled upward through the dust of the hot road, until at last he reached the summit of the San Juan grade and saw spread before him the broad acres of the Salinas Valley, carpeted with a solid mass of golden color. On closer inspection he found this color to be of wild mustard in bloom. In disappointment the pioneer, seeking a farmstead, said to himself: “This land is good for nothing; mustard can never be stamped out.” He moved on to seek other and more favorable prospects.

What a surprise would be in store for this same pioneer if he could come back today and, lolling at his ease in a luxurious limousine rolling smoothly on rubber tires over concrete pavement, could mount the same San Juan grade in a few minutes and suddenly see before him those same broad acres of the Salinas Valley carpeted with various shades of green, the gray green of the Guayule rubber plantations, the deep green of wide alfalfa fields, spotted here and there with herds of black and white dairy

cattle, and the light green of thousands of acres of lettuce fields! What would be his thoughts when he learned that this same land which he had pronounced good for nothing now supports a prosperous population of more than 40,000 souls, who are pleased to term it the “Valley of Green Gold”?

This region is of special interest to our company, for by its purchase of the properties of the Coast Valleys Gas and Electric Company it added Monterey County and the Salinas Valley to the already vast territory covered by the transmission lines of “Pacific Service.”

In a recent issue of PACIFIC SERVICE MAGAZINE the story of the development of the new Guayule rubber plantations in the Salinas Valley was told. This, however, is but one of several new crops that bid fair to enrich the peoples of this great farming area. Many changes have taken place since the days of the pioneer and the waving fields of yellow mustard.

First came the cattle barons, holding thousands of acres under Spanish grants and producing cattle to be sold for one or two

dollars per head. The hides and tallow were all of the animal that was of value. Then followed in the flat lands of the valley the wheat grower, who pushed the cattle back into the hills and mountains that buttress the valley on either side. After wheat came sugar beets, and a great factory was erected by the Spreckels interests



Lettuce field near Salinas. This produced 49 carloads from 43 acres.

at a point about three miles south of Salinas, said to be the largest beet sugar factory in the United States, with a capacity of 3,000 tons of beets per day. Along with the sugar beet came the dairying industry and its close attendant, alfalfa culture. It was found, also, that beans were a profitable crop, and in this historical review we must not overlook the humble potato, because for a time the Salinas Burbank variety enjoyed a considerable reputation.

But times are still changing rapidly and the generation of today is finding a new crop that brings returns far in excess of the fondest hopes of the residents of yesteryear. Land which fifteen years ago brought to its owners a rental of nine to twelve dollars per acre for beet culture is now bringing in rentals of fifty and sixty, in some cases as high as eighty, dollars an acre, planted to such highly productive crops as artichokes and, more extensively, lettuce and other green vegetables.



Field crates used in harvesting lettuce crop.

The lines of "Pacific Service" in the Coast Valleys Division supplied electric energy to pump irrigation water for more than 15,000 acres of lettuce in 1928, serving some 3,000 horsepower of pumping motors and thereby playing their part in the agricultural development of the now fertile region which has earned fame through its harvest of "green gold."

Pumping water to irrigate the growing crops is not the sole contribution of "Pacific Service" to this rapidly growing infant industry. For every car of lettuce shipped, nine tons of ice are used to pack it. During the year just ended 17,913 cars of lettuce alone were shipped from the Salinas-Watsonville territory and required 161,217 tons of ice for crushing and packing in the crates, to say nothing of the amount used by the car companies for icing the refrigerator cars here and en route. Three ice plants in Salinas supply the major portion of this commodity. The connected load in these three plants, which have an aggregate output capacity of 515 tons daily, totals 1,531 horsepower.

The remarkable feature of the lettuce industry in the coast counties centering around Salinas and Watsonville is the rapidity of its growth. In 1921 and 1922 not a single car of lettuce was shipped from this territory. According to government statistics, 9,744 cars were shipped out of the State in 1922, of which 52 per cent came from the Imperial Valley and the balance in comparatively small lots from various other sections of the State.



Crate of lettuce ready to receive last layer of cracked ice. Shows waxed paper which is folded over top of pack. This is a 4-doz. pack crate.

About 1922 and 1923 some one discovered that the climate along the coast in the lower Salinas and San Benito river valleys was ideal for lettuce production and the first car was packed and shipped as an experiment. Success was its result and from that time on lettuce production in this section has grown by leaps and bounds until today there are some 15,000 acres of land devoted to this crop, 17,913 cars being shipped from the Salinas-Watsonville district during the year 1928. This shipment is equivalent to 65 per cent of the total shipped from the State of California during the year 1927 and is said to be more than the Imperial Valley ever shipped in one year. Figures for the entire State for the year 1928 are not yet available.

In 1922 the total lettuce crop produced in the entire country amounted to 22,240 cars from 44,900 acres. In 1927 the national production was 46,850 cars from 122,310 acres, and it is estimated that the total for the nation in 1928 will reach 55,000 cars, nearly 33 per cent of which comes from the Salinas-Watsonville district of California.

S. S. Rogers of the California Department of Agriculture says: "The development of the lettuce industry has been largely due to the improvement of the transportation facilities. The principal marketing

centers are situated east of the Mississippi river and a large percentage of the crop is consumed in such cities as New York, Chicago, Boston, Philadelphia, etc. Prior to 1916 these markets were supplied largely by crops grown locally near the larger markets in open fields during the summer, and in greenhouses in the colder sections during the winter. During this period Florida grew considerable lettuce, as the distance from the markets was not prohibitive. But with the improvement of the refrigerator cars and faster and more adequate railway service the lettuce-growing areas spread out into other parts of the United States where the climate, soil and moisture conditions were more favorable, and where production costs were much lower.

"Another important factor in this change has been the development of the solid head varieties, which have become more popular than the loose head and leaf types. Many of the leading dietitians have recognized the healthful qualities of lettuce, especially as it contains considerable quantities of vitamins. This fact has stimulated its use and has had a very important influence on the general demand."

Not the least important effect that the development of the lettuce industry has had on the Salinas Valley is the number of workers it has brought into this



Cutters at work harvesting lettuce crop.



Harrowing ground preparatory to bedding up for lettuce planting.

territory. It is estimated that there are more than 1000 field laborers engaged in planting, thinning, cultivating and harvesting operations. In addition to these field laborers there are a like number engaged in packing and marketing the crop. Unlike the Imperial Valley regions and other lettuce-growing States, it is possible in the Salinas Valley to plant and harvest two crops from the same acreage each year and, in a few exceptionally favorable cases, three crops have been matured in a single twelvemonth on the same ground.

Let us follow a crop from the start of preparing the ground until it is packed in the cars and starts rolling eastward to the great markets beyond the Mississippi River:

The land is first plowed and carefully harrowed. Beds are then thrown up with a ditcher. These beds are about sixteen inches to eighteen inches wide and are spaced thirty inches apart from center to center. The low ditch, or furrow, between beds serves for irrigation purposes. After the beds are thrown up, they are again lightly harrowed and then planted with either a two-row or four-row seeder. Two rows fourteen inches apart are planted in each bed. One and a half to two pounds of seed are required to the acre. Seed varies in price from \$1.00 to \$2.00 per pound.

Within from twenty to thirty-five days after planting, depending upon the weather and growing conditions, the rows are thinned, leaving plants about twelve inches apart in the row. At the same time the

weeds are hoed and the rows are cultivated.

For the spring crop usually one irrigation only is required, depending on the winter rainfall. For the fall crop three or four irrigations are usually required. Cost of power for irrigation varies from three to five dollars per acre. The total cost of production, including rent of land, seed, labor and water, is approximately \$100 per acre per year. The average crop is one-half car to the acre, although in one case a grower succeeded in taking 49 cars from 43 acres.

Crops that are planted during the summer will often mature in fifty-five days from planting to cutting. The fall and early spring crops usually require about 110 days to mature. After maturing the heads are cut by hand and thrown loosely into field crates, which are then hauled to the packing houses, where they are prepared for shipment. A packing crew consists of two trimmers, a packer, an icer and a press man.

The shipping crates are lined with two large sheets of waxed paper. The trimmers cut off the butts, large loose outside leaves and all brown leaves. They also throw away as culls all defective heads. The packer then places the heads in the crates, upside down, that is to say with the stem end up, and the icer throws in a shovelful of cracked ice. A second layer is placed on top of the first and then more cracked ice and then a third layer with cracked ice on top of that, after which the wax paper is folded back over the top and the crate placed in a press and the cover nailed on it. There are two

standard packs, four dozen and five dozen, depending on size of heads. In the former there are three layers of sixteen heads each to the crate and in the latter three layers of twenty heads each. Thirty pounds of cracked ice are used in each crate and 320 crates are placed in a car, after which a layer of cracked ice is scattered over the



One of the 35 lettuce-packing sheds in the Salinas Valley.

top of all the crates and the ice compartments of the refrigerator car are filled in the usual manner and the car is ready to roll.

There are at the present time some thirty-five packing sheds in operation in the Salinas Valley alone and three or four more under construction which will be ready for use in the spring campaign of 1929.

Most of the field labor is performed by Japanese and Filipinos. Many girls and women are employed as trimmers in the sheds.

The first crop is cut during the latter part of March or the first of April, about the time when the Imperial Valley harvest is finishing up, and there isn't a day after that until the end of December when some cars are not shipped out of this district. The peak of the spring crop comes during May, but there is a fairly heavy summer crop shipped in July and August and another fall peak during October. As many as 230 cars were shipped out in one day in May, 1928.

Iceberg or solid head lettuce is the variety grown exclusively in the irrigated lands in the West, and constitutes more than 80 per cent of the entire supply of the nation. Big Boston is a loose-leaf variety grown in the Eastern States. None of this is grown in California.



Interior of Salinas Valley Ice Co.'s plant at Salinas. Capacity, 300 tons daily. Storage capacity, 10,000 tons.

The demand for lettuce has kept pace with the rapid increase in production. Although the price is just as high, people are eating almost twice as much lettuce as they did five years ago. Even now, however, the per capita consumption for the United States as a whole is not large, being only a little more than five heads per year in 1925. The chief cause for this low consumption is to be found in the fact that many people do not eat head lettuce at all, and many others eat it only occasionally, mainly because they cannot purchase it readily throughout the year. In the large cities in which lettuce is available most of the time, the per capita consumption is from two to three times that for the United States as a whole. Just how much the total consumption can be increased by the further development of the smaller markets is uncertain. Lettuce shippers are alive to the situation.



Extensive lettuce field near Gonzales, in the Salinas Valley.

Headquarters for Drum Division Worthy of Its Growing Importance

On December 29, 1928, the new \$50,000 Drum Division Headquarters building at Auburn was completed and occupied by the various departments of the division organization. The event was appropriately celebrated by conducting "open house" during the afternoon and evening. The occasion was a great success, with over a thousand visitors passing through the doors. Light refreshments were served.

The new building is of modern construction and occupies a ground space of 34 by 74 feet. It contains two stories, a mezzanine floor and a basement. The exterior walls are of brick. An ornamental tile cornice across the front adds a proper touch, and the whole presents an imposing appearance.

The front portion of the main floor is occupied by the Collection Department, which is located in an "island" counter in the center of the public space, and the offices of the Division Manager, the District and Division Sales Managers. In the rear are located the Consumers' Records Department and the Telephone Exchange.

The mezzanine floor is devoted to displays of appliances and headquarters for salesmen and collectors. Here also are located the rest rooms and lunch room for the women employees. The lunch room and kitchen are well equipped with electric cooking appliances.



New Drum Division headquarters building at Auburn.

The second floor is occupied by the Accounting and Engineering Departments.

The basement provides storage space for records, stationery and supplies and contains a meter-testing laboratory.

The heating and ventilating are accomplished by means of an electric central heating plant located in the basement. A suction blower draws fresh air into the furnace and over a bank of heating coils having a total capacity of 92 kw., and forced to all parts of the building by means of air ducts. During the summer months the same plant forces cool air through the building.

Plans for the building were prepared by the Department of Engineering in co-operation with the Department of Public Relations and Sales and the Division. I. C. Frickstad, Architectural Assistant, was responsible for the arrangements and architectural effects. R. I. Meyerholz handled the structural and mechanical features and gen-

erally supervised the construction, assisted by C. B. Palmer, inspector.

The building was constructed under contract by J. Piasecki of San Francisco.

The story of Drum Division, like most developments of its kind, may be traced through its structural features. In the beginnings of "Pacific Service" the territory covered represented little more than a collection of water districts that were brought together under one operating head through the purchase by our company, in 1905, of the properties of the South Yuba Water Company. There was the Nevada Water District, which represented service in and around the cities of Nevada City and Grass Valley; the Colfax Water District, a little distance away from there; the Placer Water District, whose central point was found at Lake Alta, and there was the Auburn Water District, with headquarters in that cozy foothill town.



Front office at entrance, decorated for Yuletide.

So far as importance of service is concerned, probably Auburn was the most distinguished of the water districts, for its reservoirs were called upon to supply not only the town of Auburn but, also, the adjacent towns of Rocklin, Newcastle, Loomis and Penryn down to Roseville. Mr. H. M.

Cooper, present manager of Drum Division, was at one time located at Alta, having charge of Placer Water District. Then, when Placer and Auburn districts were consolidated, he took up his headquarters at Auburn. His official surroundings were modest to a degree. He made his headquarters in the upper floor of the fire-house, near the old Freeman hotel, and had for his assistant one office clerk who, in ad-



First district headquarters at Auburn, established in 1910.

dition to keeping the books, collected the bills and was not infrequently called upon to act as pipefitter or to regulate the water in the ditches. In 1910 the Colfax and Nevada systems were merged in the Placer County District, with Mr. Cooper as manager.

In 1911 the territory had developed to such an extent that larger quarters became necessary, and W. R. Arthur, former manager of the district, erected an office building on Lincoln Way for lease to the company. It is of interest to note that M. D. Liniger, present mayor of Auburn, was the contractor. At the time Mr. Cooper took possession of this building there was so much space that the rear portion was partitioned off and used for storage and as a meeting place.



Modest headquarters from which the move to the new building was made.

Our company did not own the power-distributing system in Auburn until of recent years, but it distributed power to the surrounding territory through the "Pacific Service" system, whose nearby water power plants included those at Alta, Newcastle and Auburn, purchased from the Central California Electric Company. Power was also sent out from those plants into Sacra-

mento. The Nevada City-Grass Valley territory also received power from the plants at Colgate, on the Yuba River twenty miles away, and Deer Creek, on the stream of that name some fifteen miles from Nevada City.

The real development of Drum Division, however, started with the building of our company's Drum-Spaulding system, including the construction of Spaulding dam



Lake Theodore, near Auburn, constructed in 1909.

and the creation of a great storage reservoir there and a string of modern power plants, notably Drum, Halsey and Wise, which reached down from the peaks of the Sierra Nevada to Auburn ravine. This system was placed in operation in 1913 and seven years later Drum Division was organized by the consolidation of the Placer District with the Drum and Nevada Power Districts. It now comprises the counties of Sierra, Nevada, Placer and portions of El Dorado and Sacramento, an area of approximately 4,000 square miles. The total population served is about 40,000. There are 5918 electric consumers, 2669 gas consumers and 2693 water consumers. The division is an important one in the production of hydro-electric energy. There are eight hydro-electric power plants with an aggregate installed capacity of 144,325 horsepower. There are over 300 employees on the division payroll. Water is supplied for the irrigation of approximately 30,000 acres of orchard lands.

The early history of irrigation in Placer County dates back to the year of 1878, when a Mr. Crow planted ten acres on what is known as the Threlkell ranch in grapes and peaches and irrigated his holding from a near mining ditch. Within the next couple of years, a Dr. Miller came on the scene with several hundred fruit trees which had been shipped from Switzerland around the Horn and planted about twenty acres on what is known as the Robert Hector ranch,

on the American River, and which were irrigated from the North Fork ditch, a very important mining ditch at that time. It was soon realized that on the rolling hills of Placer County fruit-growing could be very successfully carried on if an adequate supply of water for irrigation could be had.

Little progress, however, was made in fruit-raising for some years, only about 500 acres being planted, and in some years water was not available for all of this, as disputes between late miners and fruit growers over water rights left the growers without water at times for their orchards. However, there was only a limited demand for fruit as the only market was found in the nearby mining camps and small villages. But about 1878 a considerable demand grew up in the State of Nevada, due to mining activities on the Comstock lode and elsewhere, and a little later Colorado, Montana and Idaho came into the market for fruit. The water problem then became acute.

In 1879 the South Yuba Water Company, having a number of storage lakes and an ample supply of water throughout the year for the greater portion of which they had no sale, due to closing down of a number of hydraulic mines in Nevada County as a result of Judge Sawyer's anti-debris decision, purchased the Bear River canal system. Mr. John Spaulding, the company's superintendent, informed the growers that thenceforth they could be assured of water.



Lake Alta, one of the reservoirs of the old South Yuba system.

From that time on the fruit industry advanced with rapid strides.

About 1884, shipment of fruit in carloads to Denver was commenced, but it was not until the advent of the refrigerator car several years later that shipments were made in anything but small lots to any points east of the Missouri River.

In 1892 the water company commenced the construction of the Fiddler Green canal, to supply the lands west of the present highway between Auburn and Rocklin, the Boardman canal from Alta to Clipper Gap to connect with the Bear River canal, and the building of a dam for what is known now as Lake Theodore near Auburn, to furnish additional storage.

In 1905 Pacific Gas and Electric Company took over the South Yuba Water system and soon thereafter began the development that in recent years has spelled success to the Placer County orchardist. Dams were built for storage of thousands of acre-feet of water, existing canals were enlarged and others constructed for conveying water through a string of power-houses to the great irrigation system which today provides water for 30,000 acres of the finest fruit

lands in California. Each year sees hundreds of acres of land being cleared and planted, water sales increasing correspondingly.

To insure adequate water service to the many customers requires the operation and maintenance of 300 miles of canals and ten reservoirs which during the irrigation season are patrolled by ditch agents or walkers whose daily duty is to keep them in working order and see to the proper pro-rating of water to consumers so that there may be satisfactory service at all times. All of these men are subject to call, day or night, as occasion may arise, their homes being connected by telephone with division office and water superintendent's home. In off season or winter time very little water is run through the canals as the ranches then use only enough for domestic and general ranch purposes; nevertheless, the ditch agent's work continues, for as soon as one irrigation season is over it is time to get ready for the next. This work consists in building rock walls on weak banks, repairing flumes and spills, clearing brush along canals and, in the spring, giving all canals a thorough cleaning, also increasing their capacity where needed.

KEEP THE GOVERNMENT OUT OF BUSINESS

Thomas A. Edison, in a recent interview published in the *Saturday Evening Post*, discussed water power and government in business. In the course of his interview he said:

"A private monopoly which was foolish enough to put in high rates would only bankrupt itself, for no one would buy the power. There is far more danger in public monopoly than there is in private monopoly, for when the Government goes into business it can always shift its losses to the taxpayers. If it goes into the power business it can pretend to sell cheap power and then cover up its losses.

"The Government never really goes into business, for it never makes ends meet. And that is the first requisite of business. It just mixes a little business with a lot of politics and no one ever gets a chance to find out what is actually going on. I feel so strongly on the Government keeping out of business that if I had my way the Postoffice would be privately managed by contract; all the Government should have is an efficient inspection bureau.

"If necessary, the Government can own the property, but that is a question of cir-

cumstances. Certainly it should regulate the rates, although in a businesslike fashion. Then the public is protected and at the same time the ingenuity of private enterprise has a chance to function. Any large extension of the Government into business affairs—no matter what the pretense and no matter how the extension is labeled—will be bound to promote waste and put a curb on our prosperity and progress. Somehow, and probably it is in the very nature of things, a government office is below the level of a private office.

"One of the highest duties of the President is to keep the Government out of business. He would perform a great public service if he did nothing else. That is one of the many things that we can trust Hoover to do. That is his biggest job, and I should include in that job the clearing out of the bureaucracies which are growing up in Washington and becoming a wasteful nuisance. If he can keep the Government out of business and see that Government regulation is fair both to the public and to the private operators, we are going to go ahead very quickly."

The Financial Side of "Pacific Service"

Our independent auditors, Messrs. Haskins & Sells, are now engaged in their annual audit of the Company's accounts. Final earnings statement for 1928 and balance sheet at the close of the year are not therefore available for publication at the time of going to press, but will be presented to stockholders at the annual meeting on April 9, 1929, and will be published in full in the April issue of "Pacific Service Magazine."

FOURTH "PAR OFFERING" TO COMMON STOCKHOLDERS

The Board of Directors, at its meeting on December 12, 1928, authorized the issuance and sale to common stockholders, at the par value of \$25 per share, of additional common stock in the proportion of one share of new stock to each ten shares held at the close of business on February 8, 1929. The Railroad Commission of the State of California on January 23, 1929, approved of this offering.

This is the fourth "Par Offering" which has been made to our common stockholders at approximately annual intervals. Similar offerings in 1926, 1927 and 1928 resulted in subscriptions being received for 98.32%, 98.72% and 99.52% respectively of the stock offered. It is apparent from the increasing proportion of stock subscribed for that stockholders are coming to a more general appreciation of the nature and value of these subscription privileges, and the number of those failing, through negligence or lack of understanding, to exercise their rights is progressively declining. It is, of course, to the advantage of every common stockholder either to subscribe for the proportion of stock to which he is entitled, or to dispose of his rights for their cash value.

SALE OF 5½% FIRST PREFERRED STOCK

At the beginning of the current year, the Company placed on sale "over-the-counter" at its par value of \$25 per share, a limited amount of 5½% First Preferred Stock. The new issue is similar in all respects, excepting the dividend rate, to the 6% First Preferred Stock which has for many years been well known to investors in public utility securities throughout the country, and which is now held by upwards of 31,000 stockholders.

The new issue met with a favorable reception, as indicated by the fact that up to the close of business on January 26, 1929, 4,601 subscriptions were received for an aggregate of \$4,417,775 par value of stock. The Company restricted the amount of individual subscriptions, and all of this stock was sold in relatively small blocks, the average subscription amounting to \$960.

In the twenty-two working days since the stock was first offered to the local public, sales averaged over \$200,000 per day.

Seventy-five per cent of the stock sold was purchased outright. The easy payment method of subscription is, however, popular with subscribers of moderate means, the remaining 25% being purchased on the installment plan by 2,058 investors, or 45% of the total number of subscribers. Of the 4,601 subscriptions received, 3,221, or 70%, were from new stockholders.

RECENT ACQUISITIONS

The Company has recently acquired all of the outstanding capital stock of the Novato Utilities Company and the Oakdale Gas Company, two relatively small utilities located within its operating field.

The Novato Utilities Company supplies electric, water and telephone service in Novato, California and immediately adjacent territory, purchasing electricity at wholesale from the Pacific Gas and Electric Company for redistribution. The Oakdale Gas Company furnishes gas service in the town of Oakdale, California.

Both of these acquisitions will result in the establishment of lower rates to consumers in the territory affected, together with improved standards of service naturally incident to the greater facilities of the larger organization.

YEAR 1928 ONE OF NOTABLE ACCOMPLISHMENT—RECORD SALES AT REDUCED RATES

By A. F. HOCKENBEAMER
President, Pacific Gas and Electric Company

The year 1928 was one of substantial growth and constructive development for the gas and electric utilities of California. It may be viewed retrospectively with much satisfaction by the millions of customers served by these utilities and also by the hundreds of thousands of investors who contributed the capital that has made possible the rapid expansion of facilities necessary to meet the growing needs of the State. Those served by these utilities have had the benefit of additional rate reductions aggregating millions of dollars. Those contributing the capital have witnessed the increasing serviceability of their properties, a well founded and growing optimism with respect to their future, and substantial advances in the market values of their investments.

New peaks were achieved in 1928 in the volume of sales, in earnings and in the number of customers served, to mention only a few of the commonly accepted indicia of growth. Industrial and commercial conditions were not such as to give adventitious aid in achieving these results. They were, in a very large measure, attained by the vigorous initiative of the utilities in selling their services to the public. All the major utilities carried out comprehensive sales programs, courageously conceived, intelligently planned and vigorously executed. Sales were stimulated by lower rates made possible by economies arising out of efficiencies in management, increased volume of production and distribution, the absorption of smaller companies, the refunding of outstanding obligations at lower interest rates and the securing at lower cost of new capital for plant expansion.

Approximately 480,000 h.p. of new plant capacity was added to central electric stations in California during 1928. This is unquestionably a record. In past years the preponderance of new installations has been in hydro-electric plants, but in 1928 more than 50 per cent of the added plant capacity was in steam electric generating units. The efficiency of steam plants burning fuel oil or natural gas for the generation of electric energy has been notably improved during recent years and new and powerful units of the most modern type were placed in service in 1928 by the Southern California Edison Company, Pacific Gas and Electric Company, and Los Angeles Gas and Electric Corporation. Installations of this character located within, or close to, centers of distribution are being utilized not only for standby and peak load purposes, as in the past, but also to carry increasing proportions of base loads. The most advantageously located hydro-electric situations having, to a large extent, been developed, it is undoubtedly true that the economic advantage of many of the remaining water powers has been greatly diminished by the rapid advance in the art of electric generation by means of large, modern steam plants.

The outlook for the year 1929 is encouraging and will witness a continuation of load-building efforts and expansion of facilities on the part of the gas and electric utilities. The following major projects of the Pacific Gas and Electric Company will afford an index of what may also be expected on the part of other large California companies:

1. Continuation of hydro-electric developments on the Mokelumne River at an ultimate cost of approximately thirty-five million dollars; the first unit to be completed in 1931 and the last in 1933.
2. Beginning the installation of 200,000 h.p. of the most modern type of steam turbine units in San Francisco at an eventual cost exceeding eight million dollars.
3. Bringing natural gas to San Francisco and the East Bay region in 1929 at an approximate cost of twelve to fifteen million dollars.
4. Continuation of its active load-building program, for which one million dollars has been appropriated.

This measures to some extent the contributions that will be made by the gas and electric utilities to California's growth and prosperity in 1929.

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

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The National Electric Light Association, through its Rate Research Committee, recently concluded an investigation of rates for electric light and power throughout this country and issued a report comparing rates charged by privately owned and operated plants with plants under municipal ownership and operation.

This investigation was undertaken because of constantly recurring criticisms by those interested in proclaiming the advantage of municipal and government ownership. The committee found that in many cases specific figures purporting to give existing rates were wrong and, in others, comparisons of rates as between localities or different classes of customers were made without consideration being given to many important factors, thus totally invalidating the comparison. The usual method adopted by the critics, according to this report, is to select the lowest rate charged by some municipal plant as a criterion by which to compare all private company rates, without any mention of the subsidy which often makes such low rates possible or of the materially higher rates of other municipal plants. For example, states the report, the officials of the municipal electric plant at Los Angeles, California, in a public advertisement misstated the residence electric rate situation in the city of St. Louis, citing a chance small customer's bill as representative of residence rates in that city, whereas, the facts show that the average residence rates are materially higher in Los Angeles than in St. Louis. As a matter of fact, in 1926 the net rate to St. Louis customers was actually 20 per cent lower than similar rates in Los Angeles.

The report cites also an article which appeared in several anti-corporation newspa-

pers purporting to show maximum rates and net monthly bills for use of 34 kilowatt-hours in some nineteen large cities as compared with those in four cities served by municipal plants. A check of the published figures showed that the net bills quoted were accurate in only five of the nineteen cities. The net monthly bill shown for Atlanta, Georgia, was 7 per cent higher than the correct amount; for Baltimore, Maryland, 29 per cent too high; for Buffalo, New York, 30 per cent; Denver, Colorado, 9 per cent; Detroit, Michigan, 15 per cent; Milwaukee, Wisconsin, 20 per cent; Portland, Oregon, 23 per cent; San Antonio, Texas, 18 per cent.

Concerning the situation in Ontario, Canada, which is quoted so frequently by the critics of the light and power industry, the committee has this to say:

"Study has also been made of the rate situation in Ontario, looking to the comparative trend of domestic, commercial and power rates, with the analysis disclosing that the classification is not, as frequently alleged, based upon cost of service to the class, but upon other considerations, the most important of which is that of political expediency—the domestic customers being favored at the expense of the commercial business. This is confirmed by the recent report of the Commissions of Toronto, which admits that domestic service in Toronto has been rendered at less than cost and announces increases in domestic rates."

The committee calls attention to the fact that up until 1920 the relation of rates in Ontario, as between domestic and commercial consumers, was similar to that in the United States. Up to that time the domestic consumer who uses the smallest amount of energy, requires relatively large station equipment for his use and who uses his energy but a few hours of the twenty-four, paid the highest unit rate. Now, however, the policy in Ontario has been reversed. The commercial customer, although he buys wholesale and can be served at less cost, pays considerably more than the domestic consumer.

The committee's report presents a comprehensive study of the average monthly net bills for domestic service as charged by twenty-four of the largest municipal plants as compared with the average monthly net bills of the private companies in twenty-four of the largest cities in the country under

he 1928 rate schedules. This comparison demonstrates that, as a whole, the customers of a number of widely quoted municipal plants are not as well off as those served by public utility corporations under private ownership. For example, the average municipal plant customer who uses 90 kilowatt-hours per month will have a bill of \$4.58 while the customer of the private plants using the same amount of current will have an average bill of \$4.17. But, as the committee points out, the private company must turn over ten per cent of its gross revenue for taxes. If they could be exempted from taxation, as the municipal plants are, the average bill of the householder obtaining his electricity from the private company would be \$3.75. In the case of the customer who uses only 60 kilowatt-hours the average rate of the twenty-four municipal plants results in a bill for \$3.36 while the average rate of the private plants operating in twenty-four large cities results in a bill for \$3.16. Here, again, if taxes are deducted the rate results in a bill for \$2.84.

Electric service in the United States is rendered in three broad classifications. Of the total revenues received from the public, those from domestic service make up a little less than one-third; those from small commercial (shops, offices, etc.), industrial and municipal service make up a little less than one-third, and those from larger power service and traction constitute the balance or a little more than one-third.

The electric industry is unique among enterprises in that the product is not a tangible commodity but an invisible force. Except to a very limited extent by means of storage batteries, it cannot be made in advance and kept in a warehouse in anticipation of expected requirements. It cannot be prepared in slack seasons for use during rush hours; it must be made instant by instant in exact proportion to the quantity demanded. Further than this, and still because of its unique nature, it necessitates a complex and expensive procedure to transport it from the place where it is made to the place where it is finally to be used.

Electricity at the power-house switchboard is now produced at a very low cost. Except in a few special instances, it varies (with all items included) from a little under one-half of a cent to a little over one cent a kilowatt-hour, depending on conditions.

For consumers, the power house is, however, only the beginning. As in all other industries, the product must be transported, in bulk, to its market. Sometimes this is over long distances. All this costs money; to the expense of poles, towers and wires and of the land which these occupy, there must be added the cost — which increases rapidly as the distance lengthens — of the electricity lost in the process of transmission.

Once at its market, electricity must still be distributed to each of its consumers. It costs the corner grocer considerably more to deliver his goods at retail to his customers than it does the wholesaler to deliver the same goods in bulk form. In the same manner, the cost of the retail delivery of electricity is usually much larger than the cost of its transportation from the power house to the local substation. The lines of poles or of underground mains in practically every street, the transformers which change the higher electrical pressure of the transmission and distribution systems to the low pressure required for domestic use, the individual wires which lead in from the street, and, finally, the switch and meter on the consumer's premises, all entail large costs of construction, operation and service. When these are spread over a large number of kilowatt-hours used for industrial power, the resulting cost per unit is low; when they are spread over the small number of kilowatt-hours taken by the average domestic consumer, the resulting cost per unit is greater.

In addition to all this, the current taken by the domestic consumer must bear the expenses inherent in the periodical collection of small amounts of money. It does not cost any more to read a meter and render a bill for 3,000 kilowatt-hours than it does for 30. If all commercial expenses should total thirty cents a month per customer and are spread over 3,000 kilowatt-hours, the figure per unit is negligible; if it is spread over thirty units or kilowatt-hours it comes to a cent per kilowatt-hour, or probably more than the power has cost at the plant.

The price of electricity is thus inevitably higher to the domestic user than it is to the consumer of industrial power and cannot be materially altered by any purported supply of "cheap power at the switchboard." In spite of this, however, the price of service to the domestic consumer is steadily declining.

IS PUBLIC SENTIMENT CHANGING IN ONTARIO?

In a recent article upon the affairs of the Hydro-Electric Commission of the province of Ontario, Canada, Mr. Floyd Chalmers, managing editor of the *Toronto Financial Post*, presents facts and figures which tend to reveal a change in public sentiment toward that widely advertised experiment in state ownership of hydro-electric power.

"Developments are taking place which indicate that people will not tolerate any further substantial investment of public funds in public ownership of power," writes Mr. Chalmers. "This does not mean that the death knell has rung for Hydro, as the system is familiarly called. A publicly owned enterprise, serving over half the province and distributing over 1,000,000 horsepower of electrical energy, is too big a thing to be unscrambled in a day or in a year, and it may be doubted if any serious effort will be made to sell it out piecemeal to private companies within the next decade. But public sentiment is now tending definitely to limit the extent of the public power enterprise to its present field of service and to avoid the expenditure of further large sums of money, either on major generating plants or on distribution systems in new communities."

Mr. Chalmers bases his conclusions upon several points, of which the following may be quoted:

"The Ontario Hydro-Electric Commission seeking around for new power sources recently contracted for 250,000 horsepower of electric energy from a private company in the adjoining province of Quebec. Paying \$15 per horsepower for it at the plant, the Commission will bring the power 260 miles to Toronto at a laid-down cost of \$22 per horsepower less than Toronto is paying today for power purchased from Niagara Falls, a little over 100 miles away."

"Toronto people have discovered that they are able to go 260 miles to buy power from the private company, taking only one-half of the output of the company, pay a price for it that will net one and one-half times the bond interest on the whole first mortgage issue of the company and yet lay it down in Toronto cheaper than the far-famed Chippewa and other public-ownership plants with all their natural and tax-free advantages have been able to do."

"Recently a group of American public

utility operators, the W. B. Foshay Co., came into Ontario and made offers to purchase locally owned power plants from a number of small towns in the western peninsula, including Southampton, Walkerton, Chippewa Hill, Port Elgin and Wiarton. Their offers have been accepted in three towns, and are in process of being accepted in others. The Hydro Commission has sent its strongest orators into the field trying to prevent this 'raid' into what they think should be their territory, but they have been given the cold shoulder. . . .

"Power rates have been held down in Ontario to some extent because the publicly owned system has paid practically no taxes. Premier Ferguson, a rather level-headed business lawyer, dropped a disturbing bomb a few months ago. The municipalities through which run the power lines that carry current from Niagara Falls to the city of Toronto asked the government for the privilege of collecting municipal taxes on those lines. In brief, the Prime Minister's reply was, 'My heavens, you can't do that. If you tax those lines, you will increase power rates in Toronto 20 per cent to 25 per cent.' His statement proved rather embarrassing to hydro propagandists generally. . . .

"House-lighting rates in the Ontario hydro belt are cheap, but industrial power is very costly. This is no new discovery to independent engineers and investigators, who have long realized that the domestic consumer—the voter, in other words—in Ontario has gotten his power at less than cost and that the losses have been soaked to the manufacturers and hidden in street-lighting, traction and other power rates. . . .

"The officers of the largest municipal commission operated as part of the Ontario system have just admitted that this is what has happened. Toronto, a city of 650,000 people and the heart of the public-ownership movement in Canada, is raising its domestic current rates on a basis that will increase every house-lighting bill in the city anywhere from 15 to 85 per cent. In backing up the demand for the increase the general manager of the Toronto system, in interviews in the newspapers, let it be known plainly that all this time the householders have been getting their power at less than cost and that now the practice would have to stop. . . .

"Ontario is for public ownership. Quebec, with its ancient traditions, its serious-

mind, hard-working population and its implicit belief in the property rights of the individual, is private ownership in theory, doctrine and practice. There was never another such perfect opportunity for comparison of the actual results, in practice of public and private ownership. Yet, in power rates, Quebec has put it all over Ontario, and Montreal has put it all over Toronto. . . .

"A direct comparison between power rates in Ontario and Quebec and between rates charged by the Toronto system and the Montreal company shows advantages entirely in favor of the Quebec and Montreal consumers. The significance of these figures is so great that many observers view them as the final answer to the question of private versus public ownership of power."

Mr. Chalmers regards the change of sentiment in Ontario as typical of a development that is taking place throughout the whole of Canada. He points to the fact that three large utility holding companies have been active in western Canada in the purchase of existing power and light plants from municipalities. These groups are the International Utilities Corporation, the Calgary Power Company and the Dominion Electric and Power Company. Between them they have acquired, during the past year or two, lighting and power systems in at least two score western communities. Mr. Chalmers goes on to state:

"Manitoba faced a power shortage recently. The solution lay in the development of a site at Seven Sisters Falls on the Winnipeg River. A strong campaign was conducted, urging the development of this site by the provincial power commission. But the former government of Premier John Bracken refused to accede to newspaper demands and saw to it that the power site was given to a private company, the Winnipeg Electric Company, one of the Power Corporation of Canada group of enterprises. The Winnipeg Electric has already formed a subsidiary company, the Northwestern Power Company, to develop its new site.

"It was no less a person than the consulting engineer of the Ontario Hydro-Electric Commission who went to Manitoba and summed up his lengthy report on this development, made to the Manitoba government, with the sentence that 'the province's position . . . can be protected adequately without committing the province at this time to excessive capital expenditure with the prob-

able danger of financial unsoundness.'"

Mr. Chalmers declares that investigating visitors to Ontario run across a considerable anti-public ownership sentiment that was absent five or ten years ago. They find that a more critical viewpoint prevails. "The situation today is that even Ontario is beginning to lose its reckless conceit in the good work of public ownership of the people's light and power," writes the financial expert.

Mr. Chalmers' article has attracted considerable public attention. It is of particular interest to persons interested in the public service for the reason that through its Hydro-Electric Commission the province of Ontario during the past twenty or more years has made the most extensive experiment in municipal and state ownership of utility property and service that has ever been attempted on the American continent. The Commission has been given financial credit limited only by the resources of the province and political power and authority to an extent rarely granted to administrative agencies of representative governments. The following extracts from the legislative acts which created this Commission will serve to indicate the tremendous plenary powers delegated to it:

"To acquire by purchase, lease or otherwise, or, without the consent of the owner thereof or of any person interested therein, enter upon, take possession of, expropriate and use the land, waters, water privileges, water powers, works, machinery and plant of any person owning, holding under lease or otherwise, or developing, operating or using the same for generating, or adapted for generating, electrical power or energy or for the transmission thereof in Ontario; and develop and use the same for any of the purposes of this Act."

"To enter upon, take and use, without the consent of the owner thereof, any land upon which any water power or privilege is situate, or any lake, river, stream or other body of water which, in the opinion of the Commission, is capable of improvement or development for the purpose of providing water power, and construct such dams, sluices, canals, raceways and other works as may be deemed proper or expedient for that purpose."

"To enter upon, take and use, without the consent of the owner thereof, any land which may in the opinion of the Commission be necessary for the full enjoyment and

exercise of any water right, water privilege or improvement undertaken by the Commission."

"To acquire by purchase or expropriate any plant, machinery, appliances, wires, poles and other equipment, and the land occupied by or used in connection with the same or any part thereof, used or intended for the distribution of electrical power or energy in a municipality, the corporation of which has entered into an agreement with the Commission for the supply of electrical power or energy."

"The foregoing powers may be exercised without any prerequisite or preliminary action or proceeding and without any other sanction or authority than is conferred by this Act, and shall include the right to take, acquire or retain possession for such time as the Commission may deem proper, and under agreement with the owner or person interested, or without his consent, of such lands or of such estate, right, title, privilege, easement or interest in, over, upon, or in respect of or relating to any land as to the Commission may seem desirable or expedient."

"Without the consent of the Attorney-General no action shall be brought against the Commission or against any member thereof for anything done or omitted in the exercise of his office."

Such delegation of power to an administrative agency was a radical departure from the constitutional limitations of executive authority characteristic of nearly all elective governments. Students of political science who subscribe to the principle that the proper function of government is to govern have expressed their misgivings as to this experiment. To them the quality and character of utility service supplied and the solution of the problems of economics and finance involved in that service are of secondary importance to the results anticipated from subordinating an essential industry to politics, from strengthening a political organization by giving to it control of a great utility service and the support of the voting power and influence of its operative personnel.

The Hydro-Electric Power Commission of Ontario is primarily engaged in the production and transmission of electric power, the distribution and sale, except to certain large industrial plants, being handled in local units owned and operated by the various municipalities. All of the operations of

these municipal distribution systems are subject to the supervision of the Commission. The rate schedules are fixed, the service standards are defined and the accounting methods are prescribed by the Commission, and the books and records are subject to periodical audit and check. No indebtedness may be incurred except under the Commission's approval. The reserves and sinking funds are set up in accordance with the Commission's orders. Obviously, these municipalities are given very little autonomy in applying local power service. It is claimed for the Commission that in its regulation and supervision of the municipal utilities it has been evidently successful, that such abuses as exist are of minor importance in comparison to what would have resulted from the operation of these properties under the unregulated direction of local politicians. On the other hand, local autonomy and initiative have unquestionably been subordinated to the policy of the Commission. If each local system is manned by an underpaid personnel limited to the conduct of a fixed routine, sapped of all courage and vision by an unyielding system of procedure prescribed and enforced by the central authority, utility service must inevitably fall short of its duty to the community and ultimately involve all industries dependent upon it in its own stagnation. The qualities and capacities of mind which make for industrial progress cannot be treated as matters of abstract arithmetic, but find expression only in an atmosphere of freedom.

At the beginning of its operations, before acquiring or building any power plants, the Commission purchased power from two Niagara Falls developments at a flat price of \$10.40 per horsepower per year. It has since acquired both of these developments, but does not appear to have produced any power, at Niagara Falls or elsewhere, for as low a figure as that fixed in these original purchase contracts. Throughout its entire history the lowest rate charged by the Commission to any of the municipalities for power supplied for resale has been applied to the city of Ottawa for power generated by a privately owned plant and delivered directly to the municipality without passing through the Commission's system. The Commission has purchased power from a number of other privately owned plants throughout its history at prices substantially lower than the cost of production at its own plants. It would appear that the Commis-

sion, as a producer of electrical energy from water-power plants, has not been able to equal the efficiency attained by private enterprise in the operation of smaller stations in the same territory.

This condition is even more significantly marked in the cost of operating the Commission's transmission system. The cost of power delivered to the various municipalities (including Ottawa) is substantially higher than the resale rates in effect in California, although the cost of power production in Ontario is very much lower, if the prices paid by the Commission at Ottawa and Cornwall are a fair indication.

The Commission supplies service to eleven cities, six rural power districts and two industrial plants situated along the north bank of the St. Lawrence River from a detached transmission system known as the "St. Lawrence System." Power is obtained from the Cedar Rapids Power Company, delivery being made at Cornwall Substation, which is about 50 miles from the company's generating station in the Province of Quebec. During the year 1928 the contract called for 7,865 horsepower, a peak load of 8,312 horsepower was recorded, and a total delivery of 31,607,500 kilowatt-hours reported, the total cost being \$127,005.21, or \$16.15 per horsepower contracted, or approximately 4 mills per k. w. h. delivered. Cornwall is approximately the same distance from the Cedar Rapids power house as Hamilton is from Niagara Falls. During 1927 the Commission charged the city of Hamilton \$798,481.88 for delivering 32,196.9 horsepower to that city for redistribution, or an average of about \$25 per horsepower. The Commission's report does not show the kilowatt-hours delivered to the city of Hamilton, and a comparison of costs per k. w. h. cannot be made from the data available.

Numerous instances of this nature could be quoted. The cost of operating the St. Lawrence system—a purely transmission system—for example, appears to be very much higher than justified by the mileage of lines or the extent of the business, and the rates paid by the eleven cities for power average nearly twice the California resale rates. No details of executive costs are given in the Commission's reports—even the total sum is not reported—but the range of administrative activities and functions is outlined in the operative statements and indicates very clearly that a large personnel is

employed, the cost of which must be an important factor in the charges for power. If the expenses of the organization assigned to the discharge of the Commission's political functions and activities, including the exercise of its regulatory powers, were deducted from the cost of supplying utility service, it seems reasonable to expect that a very much better showing would be made.

The Commission's reports show that 44 municipalities were supplied with power for redistribution by the Commission during 1912-13. The rates for this service, in the main, decreased substantially during the following years, reaching a minimum in 1919 and 1920, and then took a sharp upward turn which does not yet appear to have reached its maximum. Of the 44 cities referred to, 17 received service at lower rates in 1927 than at the beginning, 26 at higher rates, and one at the same rates. Of the 17 with reduced rates, four were lower in 1927 than during any previous year, while of the 26 with rate increases, fifteen were higher during 1927 than during any previous year. As the large cities of Toronto and Hamilton are in the latter group, it seems apparent that the upward tendency of costs continued to the close of 1927. It is interesting, also, to note that in 1912-13 seven of the 44 municipalities received power service at lower rates than the California resale schedules, while not one of them did so in 1927.

The rapid development of electrical science in progress in Ontario and elsewhere at the time of the organization of the Commission was ample evidence that the industry did not require the stimulus of the vast powers delegated to that body, and the obvious inference is that the Ontario idea had other objectives than utility service. It must follow that the subordination of utility service to the attainment of these objectives will inevitably be attended by impaired efficiency and increased cost, and by augmented tax burdens upon the communities served. These results are becoming apparent in the statistics embodied in the Commission's reports.

The most important contribution of electrical science to progress is the stimulus it has given to the cultural progress of the race: not the machine it has devised, but the capacity it has developed in man to design and build that machine. It is in these aspects that the Ontario Commission has recorded its maximum failure.

In Memoriam

The Grim Reaper has laid a heavy hand on the man-power of "Pacific Service" during the past six months. No fewer than 24 trusted employees of our company obeyed the last call. Each one of these, no matter what his position in the company, was an integral part of the corporate organization and his loss is keenly felt.

Frederick Charles Piatt, Assistant Executive Engineer, died November 20th. He was a native of California and attended the State University, graduating therefrom with the degree of electrical engineer in 1909. Shortly thereafter he entered our company's employ and rose, step by step, to the position he occupied when he passed away. Mr. C. P. Cutten, Attorney of the Rate Department, in his official capacity came into close contact with Mr. Piatt and knew intimately the man and his work. The following tribute is from the pen of Mr. Cutten:

"Mr. Piatt early showed marked ability in his profession and was chosen from time to time to make important engineering and economical studies. The valuation of the company's entire electrical system presented before the Railroad Commission in 1922 was made under his supervision. The quality and thoroughness of this work were generally recognized and greatly added to his growing reputation. His most important work since the completion of the electric property valuation was his excellent study in determining and explaining the damage which the company would suffer by the severance of its electric properties in San Francisco from the co-ordinated 'Pacific Service' system. Whatever he did he did with his might, and put the best of himself into every task. He was endowed with quick perceptions and a keen, well-trained mind, and possessed an unusual degree of the capacity to 'think through' in solving complex problems."

William Granville Jack, manager of the Land Department, passed away at his home in San Francisco, December 18th, aged 65 years. Mr. Jack was a native of Maine. In his early manhood he came West and for several years engaged in mining operations in Alaska. Coming to California, he entered the employ of the Ora Electric Corporation and was its secretary until 1915,

when he entered our company's employ. In 1923 he was made manager of the Land Department. Mr. W. G. Vincent, our company's Vice-President and Executive Engineer, under whom Mr. Jack served, writes:

"In his death not only has the company lost an unusually capable executive, and the department of which he was the manager an efficient and inspiring leader whose unfailing courtesy, sincerity and friendly manner won the confidence of all who knew him, but those of us whose privilege it was to come in daily contact with him have lost a valued associate whose generosity, sympathy and understanding had won our admiration, respect and friendship."

Leo H. Susman, our company's General Attorney, succumbed to a heart attack at his home in San Francisco, December 19th. He was a native of Tasmania, born there in 1879, but came to California with his parents as a boy and attended the public schools in San Francisco. He then went to Stanford University, from which he graduated in law in 1901. He was in private practice for three years and, during that time, served one term as a member of the Assembly of this state. From September 1, 1904, until his death, he practiced his profession in the Law Department of California Gas and Electric Corporation and its successor, Pacific Gas and Electric Company. For nearly seven years he was head of the department, having been promoted to that position in the latter part of January, 1922.

During the period from 1909 to 1922 Mr. Susman was a member of the faculty of the San Francisco Law School, and was president of that institution from 1923 until his death. Mr. W. B. Bosley, our company's General Counsel, says of him:

"Possessed of marked ability, sound judgment and integrity of character, honorable in all professional and personal relations and every ready with friendly aid, Mr. Susman won a high place in the esteem and friendship of his associates."

C. E. Kunze, editor of *P. G. and E. Progress*, died of pneumonia at his home in Mountain View, December 20th. For many years he was prominent throughout the state of California as a newspaperman, publicity director and writer upon public topics of the day. Though he had been in our company's employ but a short while when he passed away he nevertheless had made his mark.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 1,002,000 CONSUMERS OF
GAS ♦ ELECTRICITY ♦ WATER ♦ STEAM
 2,515,901 Total Population Served in Thirty-eight of California's Counties
 CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL	
	No.	Population	No.	Population	No.	Population
Electricity.....	313	1,751,622	36	163,675	349	1,915,297
Gas.....	85	1,783,375	5	14,702	90	1,798,077
Water (Domestic).....	20	24,100	4	18,500	24	42,600
Railway.....	1	105,000	.....	.....	1	105,000
Steam Heating.....	2	1,003,000	.....	.....	2	1,003,000
Place..... Population	Place..... Population	Place..... Population	Place..... Population	Place..... Population	Place..... Population	Place..... Population
Acampo..... 1,000	Cottonwood..... 704	Hillsborough..... 1,000	Newark..... 1,100	Saratoga..... 1,300		
Agnew..... 125	Coyote..... 250	Holister..... 4,500	Newcastle..... 750	Sausalito..... 3,800		
Alameda..... 35,140	Crockett..... 2,500	Honcut..... 500	Newman..... 1,250	Seaside..... 350		
Albany..... 6,000	Crows Land- ing..... 300	Hopland..... 500	Niles..... 1,850	Sebastopol..... 2,000		
Alamo..... 100	..... 300	Hughson..... 625	Nord..... 200	Shawmut..... 100		
Alleghany..... 300	2 Daly City..... 6,500	Hydesville..... 200	Notoma..... 200	Shasta..... 46		
Alta..... 100	Danville..... 500	Inverness..... 215	2 Novato..... 1,000	Sheldon..... 300		
Alton..... 200	Davenport..... 500	1 One..... 900	1 North Saera- mento..... 2,500	Shellville..... 200		
Alvarado..... 1,120	2 Davis..... 1,750	Irvington..... 1,200	..... 2,500	Sheridan..... 50		
Alviso..... 640	Dayton..... 60	3, 4 Jackson..... 2,500	2 Oakland..... 2,000	Shingle Springs..... 40		
Amador City..... 750	Decoto..... 700	3, 4 Jamestown..... 1,000	2, 4 Oakland..... 295,000	Smartsville..... 300		
Anderson..... 1,180	Del Monte..... 300	Jenny Lind..... 100	Oakley..... 300	Soledad..... 475		
Angel Island..... 500	Denair..... 400	Junction City..... 600	Occidental..... 155	6 Soquel..... 875		
Antioch..... 2,800	Diamond Springs..... 200	Kelseyville..... 600	Olema..... 155	6 Sonoma..... 1,000		
Applegate..... 100	Dixon..... 1,200	Kennett..... 492	Orland..... 2,100	5, 6 Sonora..... 3,500		
6 Aptos..... 200	Dobbins..... 100	2 Kentfield..... 1,000	2, 8 Oroville..... 7,000	5, 6 Sonlsbyville..... 200		
Arbuckle..... 900	Drytown..... 200	Kenwood..... 300	Pacacho..... 300	2 South San Francisco..... 6,500		
Arcata..... 2,200	Duncan's Mills..... 250	Kewick..... 20	2 Pacific Grove..... 5,000	Spreckels..... 450		
Artois..... 200	Durham..... 600	5 King City..... 1,000	6, 7 Palo Alto..... 9,350	Standard..... 800		
Asti..... 100	..... 250	Kingston..... 100	Paradise..... 600	2, 7 Stanford Uni- versity..... 3,652		
2 Atherton..... 800	Durham..... 600	Knights Ferry..... 200	Patterson..... 700	Stanislaus..... 100		
8 Auburn..... 3,000	5 Duteh Flat..... 400	Knights Land- ing..... 525	Pebble Beach..... 300	2 Stockton..... 55,000		
Bangor..... 50	Dunnigan..... 150	..... 525	Penn Grove..... 250	6 Suivan..... 800		
Banta..... 50	Eldridge..... 100	La Fayette..... 300	Penryn..... 250	Sund..... 500		
2 Barber..... 500	2, 6 El Cerrito..... 3,000	5 La Grange..... 200	Perkins..... 50	2 Sunnyvale..... 2,700		
Belmont..... 1,000	El Dorado..... 60	La Jolla..... 1,250	Petaluma..... 7,500	Sutter City..... 500		
Belvedere..... 750	Elk Grove..... 1,450	2 Larkspur..... 1,000	2 Piedmont..... 9,000	5 Sutter Creek..... 1,000		
Benicia..... 2,750	Elmira..... 300	Lathrop..... 300	6, 7 Pinole..... 1,000	Tehama City..... 200		
6 Ben Lomond..... 500	El Verano..... 500	2 Lawndale..... 60	Pittsburg..... 8,500	Thermalito..... 250		
2 Berkeley..... 80,000	2 Emeryville..... 5,000	Lewiston..... 100	Pittserville..... 2,250	1 Thornton..... 135		
Bethany..... 50	Empire..... 250	5, 8 Lincoln..... 2,000	Pleasanton..... 1,800	Tiburon..... 500		
2 Biggs..... 750	Escalon..... 700	2 Live Oak..... 1,000	Plymouth..... 400	Towle..... 500		
6 Big Oak Flat..... 150	Esparto..... 600	Livermore..... 3,600	Point Reyes..... 310	Tracy..... 4,500		
Blue Lake..... 500	2 Eureka..... 20,000	Lockeford..... 500	Port Costa..... 960	2 Tres Pinos..... 400		
Bolinas..... 1,000	2 Fairfax..... 1,200	2, 6 Lodi..... 5,000	Potter Valley..... 600	5 Tuolumne..... 1,500		
Boyes Springs..... 400	Fairfield..... 1,200	Loleta..... 800	Princeton..... 300	5 Ukiah..... 3,000		
Brentwood..... 500	Fair Oaks..... 500	2 Loma Park..... 1,225	2 Red Bluff..... 3,500	Upper Lake..... 750		
Browns Valley..... 125	Fall River Mills..... 318	5 Loomis..... 500	2 Redding..... 5,000	6 Vacaville..... 1,300		
2 Burlingame..... 13,150	Farmington..... 300	2 Los Altos..... 1,800	2 Richmond..... 28,700	Valley Home..... 200		
Burney..... 75	Felton..... 300	2 Los Gatos..... 4,750	Richmond..... 28,700	Valley Springs..... 298		
Butte City..... 200	Ferndale..... 1,500	Los Molinos..... 460	Rialvale..... 500	2, 6 Vallejo..... 22,750		
Byron..... 400	Field's Land- ing..... 200	Lytton..... 100	Rio Dell..... 600	Victor..... 200		
Calistoga..... 1,000	..... 100	Madison..... 300	Rio Nido..... 250	Vina..... 300		
Camino..... 300	Finley..... 100	Magalia..... 100	Rio Vista..... 1,100	Vineburg..... 250		
2 Campbell..... 1,500	Florin..... 1,400	Manteca..... 2,000	Ripon..... 1,000	Walnut Creek..... 2,500		
Camp Meeker..... 300	Folsom City..... 1,500	Mantona..... 65	Riverbank..... 1,200	2 Washington..... 800		
Cana..... 500	Forest City..... 200	2 Mare Island..... 600	Rocklin..... 700	Waterford..... 400		
6 Capitola..... 450	Forestville..... 300	5 Martell..... 100	6 Rodeo..... 300	Watsonville..... 7,300		
Carlotta..... 75	Fortuna..... 1,200	2 Martinez..... 7,000	Rohrer..... 300	6 Weaverville..... 500		
Carmel..... 2,500	French Camp..... 200	2 Marysville..... 8,500	1, 8 Roseville..... 7,000	Wheatland..... 650		
Carmel High- lands..... 300	French Gulch..... 170	Maxwell..... 167	2 Ross..... 900	Williams..... 800		
Castroville..... 400	Galt..... 1,000	McArthur..... 167	Sacramento..... 105,000	Willow Glen..... 2,000		
Cement..... 1,000	Georgetown..... 300	2 Meridian..... 250	Salida..... 300	Willows..... 3,000		
Centerville..... 1,775	Gerber..... 400	2 Middleton..... 589	Salinas..... 6,500	Windsor..... 600		
Ceres..... 1,100	Geyersville..... 750	2 Millbrae..... 350	San Andreas..... 600	Winters..... 900		
2 Chico..... 12,000	Gilroy..... 3,700	2 Mills..... 50	San Anselmo..... 4,500	Woodbridge..... 250		
Chico Vieco..... 2,500	Glen Ellen..... 1,200	2 Mill Valley..... 3,500	San Ardo..... 300	2 Woodland..... 6,950		
Chualar..... 300	Glenview..... 1,200	2 Milbrae..... 400	San Bruno..... 2,175	Woodside..... 300		
Clements..... 200	Gold Run..... 50	2 Mission San Jose..... 500	San Carlos..... 1,300	Wyandotte..... 250		
Cloverdale..... 1,000	Graton..... 250	2 Modesto..... 17,000	2, 3 San Francisco..... 708,000	Yolo..... 400		
6 Colfax..... 800	2 Grass Valley..... 6,000	Mokelumne Hill..... 237	2 San Jose..... 68,000	2 Yuba City..... 4,000		
College City..... 250	Greenfield..... 350	2 Monterey..... 6,000	2 San Juan..... 500	Zamor..... 100		
Collinsville..... 300	2, 6 Gridley..... 2,500	Monte Rio..... 500	2 San Leandro..... 12,000	Total Cities and towns..... 2,031,937		
2 Colma..... 2,900	Grimes..... 500	2 Morgan Hill..... 1,200	2 San Lorenzo..... 1,000	Add Suburban Population..... 483,964		
6 Colusa..... 400	2 Groveland..... 250	2 Mountain View..... 3,000	2 San Lucas..... 300	Total Population Served..... 2,515,901		
2 Colusa..... 2,200	Guernville..... 1,200	2 Napa..... 7,000	2 San Mateo..... 11,500			
Concord..... 4,200	Hamilton City..... 300	2 Nelson..... 50	2 San Pablo..... 1,500			
6 Copperopolis..... 300	Hammondton..... 500	2 Nevada City..... 1,800	2 San Quentin..... 3,500			
Cordelia..... 350	2 Hayward..... 5,000	..... 3,000	2 San Rafael..... 7,800			
Corning..... 1,800	Healdsburg..... 3,000	..... 500	2 Santa Clara..... 6,500			
2 Corte Madera..... 1,000	6 Hercules..... 40	..... 1,000	2 Santa Cruz..... 17,500			
2 Cotati..... 600	Hickman..... 60	..... 50	2 Santa Rita..... 150			
			2 Santa Rosa..... 14,000			

Unmarked—Electricity only.

1—Gas only.

2—Gas and Electricity.

3—Gas, Electricity and Water.

4—Gas, Elect. and St. Railways

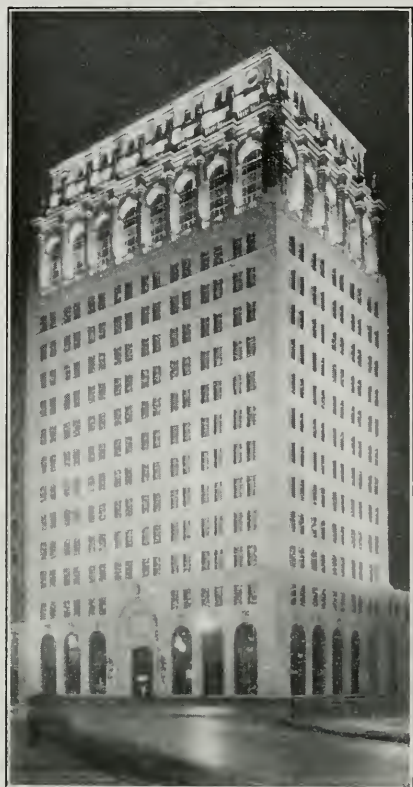
5—Electricity and Water.

6—Electricity supplied through other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.



*Pacific Gas and Electric Company's
General Office Building, San Francisco*

It Would Take a Hundred Buildings Like This

to accommodate the

Hundred Thousand
Investors

in the

BONDS AND STOCKS

of the

Pacific Gas and Electric Company

Every one of these numerous holders
of this Company's securities is
receiving a regular income
from his investment.

The Company's FIRST AND REFUNDING MORTGAGE BONDS FIRST PREFERRED STOCK COMMON STOCK

afford desirable mediums of investment in one of the largest and
soundest of the nation's public service institutions, which, with its
predecessors in title, has a record of three-quarters of a century of
successful operation.

RECORD OF RECENT GROWTH

	Gross Operating Revenue	Number of Customers	Sales of Electricity (K.W.H.)	Sales of Gas (Cu. Ft.)
1923.....	\$39,321,535	710,034	1,199,063,000	13,674,794,000
1924.....	44,451,586	763,617	1,334,035,000	15,277,478,000
1925.....	47,729,079	813,698	1,351,798,000	16,200,951,000
1926.....	50,960,571	874,724	1,514,981,000	17,482,206,000
1927.....	54,719,227	967,717	1,657,965,000	20,214,834,000
1928 (12 mos. to Sept. 30)	60,770,946	993,167	1,775,103,000	20,618,172,000

Pacific Gas and Electric Company

245 Market Street, San Francisco

PACIFIC SERVICE MAGAZINE



REDDING-PIT RIVER
HIGHWAY CROSSING
SADDLE OF
BURNIE MOUNTAIN

Vol
17

APRIL 1929

No
8

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Pacific Service Magazine

Volume XVII

Number 8

Contents for April, 1929



MOKELUMNE RIVER AT SALT SPRINGS CAMP	Frontispiece
THE "PACIFIC SERVICE" RECORD FOR 1928— NEW PEAK REACHED IN OPERATING REVENUES DESPITE REDUCTIONS IN RATES FOR BOTH ELECTRICITY AND GAS—NUMBER OF CUSTOMERS' METERS PASSES THE ONE MILLION MARK	235
"PACIFIC SERVICE" AND AGRICULTURE WEST STANISLAUS IRRIGATION DISTRICT - E. J. Neutraumont	239
ACTIVITIES IN THE GAS DEPARTMENT— NEW PROPERTIES AND EXTENSIONS	Frank Wills 243
SPAULDING-DRUM SYSTEM, as enlarged (map)	248-9
GAS SERVICE IN EAST BAY DIVISION— EXTENSION OF HIGH-PRESSURE SYSTEM	250
REDUCED RATES PROVE STIMULUS TO DIVERSIFIED USE OF COMMODITIES	J. Chas. Jordan 253
EDUCATIONAL COURSES FOR EMPLOYEES— TECHNICAL AND BUSINESS INSTRUCTION	256
THE "PACIFIC SERVICE" ROLL OF HONOR	258
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	A. F. H. 260
EDITORIAL	262



The Mokelumne river flowing placidly downstream past the construction camp
at Salt Springs development

PACIFIC SERVICE MAGAZINE

Volume XVII

APRIL, 1929

Number 8

The "Pacific Service" Record for 1928

New peak reached in operating revenues despite considerable reductions in rates for both electricity and gas. Number of customers' meters passes the one million mark.

"The best all-round showing in the Company's history" is the comment generally heard expressed concerning the "Pacific Service" record for 1928, as presented to our Company's stockholders at the annual meeting held at San Francisco headquarters, April 9th.

The record is one of unusual activity in every department of the Company's working organization. With ample production facilities available for taking care of a large volume of additional business, particular emphasis was placed upon a campaign of creative sales effort. Almost one million dollars was expended upon the largest advertising and selling campaign ever undertaken by the Company, with a resultant substantial gain in gross revenue despite the reduced rate schedules which were placed in effect in the early spring of 1928 and which represented a saving to our customers of approximately \$2,300,000 annually. Contracts for new business estimated to yield an annual revenue exceeding \$4,500,000 were secured by our sales forces, exclusive of routine applications for service. As this campaign was prosecuted unremittingly up to the close of the year, its result in revenue is only partially reflected in the income account for the year past, so that the showing made in the annual report is all the more noteworthy.

The Company's gross operating revenues in 1928, covering, as in preceding years, the operations of the Pacific Gas and Electric Company and its wholly owned subsidiaries, aggregated \$61,449,592, thus for the twenty-third consecutive year since the Company's incorporation establishing a new peak in the volume of business and exceeding by \$3,556,411 the gross revenues for 1927. Of this total the electric department was responsible for \$39,059,071, or 63.57 per cent of the whole, with an increase of \$2,705,962 over the previous year. The gas department contributed \$20,850,005, or 33.93 per cent of the total, with an increase of \$943,267 over 1927. The balance of 2.50 per cent of the Company's revenues was obtained from operation of the street railway department, water and electric department, steam sales department and telephone department. Against these operating revenues there was paid out in operating and administrative expenses and taxes exclusive of maintenance and reserves, the sum of \$27,126,832. This last item represents only 44 per cent of the gross operating revenue, as against 52 per cent in 1925, 50 per cent in 1926 and 45 per cent in 1927. The two largest items in the Company's operating expense account were: (excluding the construction forces), wages paid employees, \$11,044,729; taxes, Federal, state, county and local, \$6,419,673.

Gross expenditures for additions, betterments and improvements of service to the consumer during 1928 amounted to \$17,599,694. In the way of hydro-electric development an important achievement was the completion of a water and power project which involved an enlargement of the Company's Spaulding-Drum system, in the Sierra Nevada region. In this connection a cooperative contract was made some years ago between the Pacific Gas and Electric Company and the Nevada Irrigation District whereby the District agreed to deliver 108,000 acre feet of water annually into Lake Spaulding, during the nine months period from July to March inclusive, from its water storage sys-

tem lying about ten miles north of Spaulding, the Pacific Gas and Electric Company agreeing to transport this water through its Drum and South Yuba canals, generating power en route and finally delivering the water to the District for irrigation purposes. Under this contract, which first became effective in 1928, the Power Company agreed to pay for the use of this water an annual sum which will assist the Irrigation District in financing the cost of constructing its water storage project. The enlargement work accomplished by the Company in order to carry out the provisions of this contract included increases in generating capacity at Spaulding Nos. 1 and 2 power-plants immediately below the dam, construction of a new plant, Spaulding No. 3, on the north rim of the lake, rated at 9,383 horsepower generating capacity, and the installation of a fourth unit in Drum power-house. (Spaulding No. 3 plant was placed in operation early in 1929, so that it does not appear in the 1928 record of existing plants). The additional flow of water from Lake Spaulding down valley was taken care of by an enlargement of the carrying capacity of Drum canal. This cooperative contract is similar in character to that completed two years ago between the Pacific Gas and Electric Company and the Oakdale and South San Joaquin Irrigation Districts, which brought about the construction of the Melones plant, on the Stanislaus river. Such an arrangement is one of mutual benefit to Power Company and Irrigation District. The completion of the Spaulding-Drum project not only enables the Company to place many millions of additional kilowatt hours at the disposal of electric consumers supplied by the Company's lines but, also, insures a material increase of water supply for the irrigation of some 30,000 acres of deciduous fruit lands in the Auburn-Newcastle region.

Work at Salt Springs project, on the Mokelumne river, progressed considerably during the year. By means of a temporary diversion structure at the upstream face of the projected dam the waters of the river were diverted around the dam site by means of a 1200-foot tunnel bored through solid rock on the north bank of the stream. Bedrock at the dam site was cleaned and scraped and the work of pouring rock quarried from the hillside onto the dam abutments was carried on. At the close of the year 135,000 cubic yards of material had been so placed.

In the way of steam-electric generation, the most noteworthy accomplishment was the installation of a 50,000 horsepower horizontal turbine, of the most modern design, at Station "C", Oakland. This displaced a smaller unit of less modern character, and the net gain to the generating capacity of the station is rated at 38,204 horsepower.

At the close of 1928 our Company had 32 hydro-electric plants in operation, with an aggregate installed capacity of 654,055 horsepower. The Company's resources in the way of steam-electric generation included 9 plants, with a total installed capacity of 244,470 horsepower. In all, then, the Company's aggregate electric generating resources at the close of 1928 were 898,525 horsepower.

Much was accomplished in the way of extending and improving transmission and service facilities. During the year a new 110,000-volt double-circuit steel-tower line was constructed from the Company's high-tension substation at Newark to a new outdoor substation at Morgan Hill, a distance of thirty-four miles. It is intended to carry this line on to Salinas, where additional power facilities will be at the disposal of consumers in the region covered by the operations of the former Coast Valleys Gas and Electric Company's system.

The electric transmission and distribution facilities owned and operated by the Company as of December 31, 1928, consisted of 3,724.14 miles of high-tension transmission lines and 14,643.18 miles of distribution lines. There were 73,831 transformers connected with the distribution system, having a capacity of 914,065 kilowatts.

The total hydro output for 1928 was 1,708,429,302 kilowatt hours, an increase of 105,007,273 kilowatt hours over the record for the previous year. The total steam-electric output for 1928 was 62,833,062 kilowatt hours, an increase of 41,675,480 over 1927.

Sales of electricity during 1928 aggregated 1,765,767,000 kilowatt hours, an increase of 107,802,000 over the previous year's record. Electric service was furnished directly

to 313 and indirectly to 36 cities and towns, and to an extensive rural area in northern and central California. The Company's connected load for lighting and power purposes was 2,129,860 horsepower, of which 685,773 horsepower represented the commercial and domestic lighting load and the balance of 1,444,087 horsepower the power load. The number of customers receiving electric service from the Company at the close of 1928 was 529,306, an increase for the year of 23,681.

In the Gas Department record for 1928 some important additions to high-tension transmission systems from central manufacturing plants are noted. A 16-inch gas main was constructed from the Potrero plant in San Francisco to Lomita Park in San Mateo County, a distance of sixteen miles. This new main connects with the San Francisco-San Jose high pressure line and furnishes an additional supply to rapidly growing communities of the Peninsula district. The transmission system in East Bay Division was extended from Hayward south as far as Newark, taking in en route a number of communities not previously supplied with gas service. A twenty-two mile extension was built from the Marysville-Oroville main to Chico, and an additional main constructed to connect the Marysville gas plant with the Oroville-Chico line.

During the past year preliminaries were adjusted and the way generally cleared for a new project of unusual magnitude. Natural gas is being made available to consumers in the San Francisco Bay area through the construction of a giant pipe-line which will bring natural gas from the San Joaquin valley oil fields to San Francisco, Oakland, San Jose and adjacent territory.

For many years Pacific Gas and Electric Company has tried to find a natural gas supply available to the bay area in order to stimulate industrial development in that section. About two years ago a new gas field was discovered in the area known as Buttonwillows, about thirty-five miles west of Bakersfield. A number of gas wells were completed showing more than 1000 lbs. pressure, each well capable of delivering from five to ten million cubic feet of gas per day. More recently, test wells in the Kettleman Hills region, about fifty-five miles northwest of Buttonwillows, have been brought in with a very heavy gas pressure and there is every indication that this field will prove to be one of the greatest oil and gas producing areas in California. The discovery well at Kettleman Hills has been delivering in excess of 45,000,000 cubic feet of gas daily for several months. An opportunity here presented itself for the commercial use of a natural product which, but for conservation, would be entirely wasted. During 1928 estimates were prepared and preliminary surveys and studies made for the transmission of this gas to the centers of industry in the "Pacific Service" territory. Surveyors and right-of-way men were placed in the field, the necessary contracts were entered into and the work of laying pipe got under way in the beginning of the present year.

The project calls for a 16-inch main from the Buttonwillows oil fields, near Taft in Kern county, to Kettleman Hills. From Kettleman Hills the line will be 22 inches in diameter to Mendota, in Fresno county, where it will reduce to 20 inches and will turn west through Panoche Pass to Tres Pinos and run by way of Hollister, Gilroy and San Jose to Milpitas. At this point a metering station will be established from which two branches will take off, one to San Francisco and the other to Oakland, Alameda, Berkeley and Richmond.

The main pipe line will be 250 miles long. Including the two branches noted, the total length of line will be 282 miles. Its initial capacity will be 65,000,000 cubic feet per day, which, through the installation of additional compressor stations, can be increased to 125,000,000 cubic feet per day. The entire line will be welded throughout and will form practically a continuous tube without joints from the oil fields to the Bay area, making leakage almost impossible. Long term contracts assure an ample supply of gas for a term of years.

This project represents a contemplated expenditure of, in round numbers, \$13,000,000. It is expected to prove the greatest contribution of the present generation to the growth and development of the Bay area. Household consumers will be supplied a mixture of

natural gas and artificial gas, while large industries located close to the pipe line will be supplied with straight natural gas. Unusually low rates will be available to industries that can use gas at night and between times when it is not in great demand for household purposes. Domestic consumers will also profit. Natural gas has greater heating value than artificial gas, and the mixed gas served to domestic consumers will contain 700 heating units, as against 550 carried by the artificial gas now being distributed. With the increased heating value and with rate adjustment, the Company's management estimates that, on the basis of present business, consumers in the Bay area will save approximately two million dollars a year in their gas bills.

This great project is marked for completion by the middle of August of the present year.

At the close of 1928 the Company had 19 gas manufacturing plants in service, with an aggregate daily generating capacity of 118,668,000 cubic feet. The Company's gas distribution system embraced 5,227 miles of mains, ranging in diameter from two to thirty-six inches, operated under pressure ranging from one-quarter of a pound to one hundred pounds per square inch.

Gas sales aggregated 21,058,368,700 cubic feet, an increase of 843,534,100 cubic feet over the previous year. Gas service was furnished directly to 85 and indirectly to 5 cities and towns. There were 466,628 gas meters in active service at the close of the year.

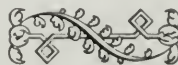
The number of patrons of "Pacific Service", including customers for electricity, gas, water and steam service, reached during 1928 the imposing total of 1,004,340. The net gain within the year was 36,623.

The Company's capital investment in plants and properties, as of December 31, 1928, is placed at \$375,585,886. Its operations extend over 38 counties of the state of California, taking in 61,000 square miles of territory, with an aggregate population of 2,500,000. At the close of the year the ownership of the Company was vested in 49,068 shareholders, of whom 30,506 held preferred stock and 18,562 common stock. California stockholders numbered 39,680, or 80.9 per cent of the total.

At the close of the year there were 9,370 employees on the Company's pay roll, of whom 4,424, or 47 per cent have a service record of five years or more of continuous employment. The Pacific Service Employees Association, a purely voluntary organization, had 7,553 employees upon its roster of membership. Under the Employees' Disability Plan conducted in connection with the Association the amount paid in benefits during 1928 aggregated \$54,476.65.

The Company many years ago placed in effect a pension system under which approximately \$600,000 has been paid to superannuated employees in the past 16 years. At the close of 1928 there were 97 pensioners on the pay-roll. Pension disbursements during the year amounted to \$70,771.

President A. F. Hockenbamer presided at the annual meeting of stockholders. Reports of progress were presented by the President and Mr. F. A. Leach Jr., First Vice-President and General Manager. Mr. Leach presented a number of views of new construction projects in the "Pacific Service" territory. At the conclusion of the meeting a resolution was adopted confirming the acts of the administration during the past year. The existing Board of Directors was re-elected.



"Pacific Service" and Agriculture— West Stanislaus Irrigation District

By E. J. NEVRAUMONT, Assistant Manager, San Joaquin Division

Through the award of a contract to supply power service to the newly created West Stanislaus Irrigation District, Pacific Gas and Electric Company is about to assist materially in the agricultural development of an exceedingly fertile section of the San Joaquin Valley lying west of the San Joaquin River.

West Stanislaus Irrigation District comprises some 22,000 acres located west of and adjacent to the San Joaquin River and almost midway between the cities of Tracy and Patterson. It extends north and south approximately eighteen miles and is traversed by a main concrete highway and a 60,000-volt electric transmission line. Its headquarters are located at Westley, a station on the Southern Pacific main line running south from Tracy.

For a decade, this section has been a gigantic grain field flowing molten at the harvest season with golden waving wheat. This, it is said, was part of the vast domain of Henry Miller, picturesque California land monarch. It has since been split up and today the vast acreage within the West Stanislaus Irrigation District is owned by seventy-nine owners. It could be easily subdivided into 1100 twenty-acre farms.

These acres do not differ greatly in topography and physiography from other parts of the great interior valley. The district is sheltered on its west by the Coast Range Mountains, but has an average annual rainfall of 10.6 inches. The region originally was basin-like, but during the course of years has been filled to great depths with alluvial wash from the adjacent mountain range, this filling material being deposited



Pumping station No. 1, West Stanislaus Irrigation District, showing pipes for lifting water 30 feet into main canal.

in clear water by various agencies operating through long periods of time. Limited records indicate that this land once supported an extensive Indian population. The Mexicans who succeeded the Indians confined their efforts to limited cattle raising and the early American settlers engaged primarily in the same pursuit. Their efforts soon turned to grain farming, which soon assumed an importance equal to that of stock grazing until, today, almost the entire acreage is devoted to grain grown on land which is allowed to lie fallow every alternate year.

The soils as classified include loams, clay loams and adobes. Soils are surprisingly deep, with no hardpan and no evidence of alkali. Elevations range from 25 to 175 feet, with a general slope of 20 feet per mile toward the San Joaquin River from the west.

As early as 1876, by special act of the Legislature, an irrigation district known as the West Side Irrigation District was created and a proposed canal from Mendota

to Antioch was surveyed. The legislative act of 1876 marked the beginning of a long struggle for water waged against economic odds, and in this the vision and energy of those pioneers and their descendants triumphed.

In 1920 the West Stanislaus Irrigation District was organized. Several of the land owners had already sunk wells and had installed electric-driven deep-well pumps, and by their use had conclusively demonstrated that this section could consistently produce diversified crops of sufficiently high values to justify a large bonded indebtedness. So thoroughly had this been demonstrated that when Engineer W. F. Woolley's report proposing a bond issue of \$1,216,376.00 was submitted to the voters for acceptance, only one dissenting vote was cast.

Water is diverted from the San Joaquin River at the confluence of the Tuolumne River. The district possesses a Division of Water Rights permit dated March 29, 1927, for a diversion of 262.15 second-feet. The ultimate demand of 265 second-feet of water will be available even during years of low flow. The supply in the river at the point of diversion includes the return flow of irrigation water from the Tuolumne and San



Main canal between pumping stations 1 and 2.

Joaquin Rivers, thus assuring an ample supply. The present plan is to apply to the land two acre-feet of water per annum. Of more than passing interest is the fact that California's two main mountain ranges have contributed the natural essentials of this project; the Coast Range mountains having provided the fertile soil, while the snow-capped Sierra Nevada Range contributed the water sheds that make irrigation possible throughout the season.

In planning this project, every natural advantage has been capitalized. At the point of diversion, the elevation of the stream bed is the lowest for miles on either side, and advantage of this condition was taken by dredging an intake canal two miles inland from the river. At that point No. 1 pumping plant is located and water is pumped to the two and three-quarters miles of concrete-lined main canal in successive lifts. A ridge of high ground seems to have been elevated in anticipation of this main canal.

Six pumping installations are required to lift the water supply to the various elevations. The first three have capacities of 270 second-feet each, the next three have capaci-



Pumping station No. 2, West Stanislaus District.
Showing transformers.

ties of 225, 135 and 90 second-feet respectively. The discharge elevations for pumping plants Nos. 1 to 6 in feet above sea level are: 58.5, 80.3, 102.8, 124.7, 147.3 and 169.7 feet respectively. The mean elevation in the intake canal is 23 feet above sea level.

The six pumping plants are housed in reinforced concrete buildings, each of which is equipped with an overhead traveling crane. Pelton pumps and General Electric motors, transformers and switchboard equipment have been used throughout. All electric equipment is automatically controlled and protected, and failure of water at the pump intakes automatically closes down the pumping units, while an overflow at the discharge reacts in like manner.

Sixty-two miles of laterals or distribution canals have been constructed and these will adequately distribute the irrigation water over the entire 22,000 acres. The concrete lining of these laterals will not be undertaken until the close of the 1929 season.

Bonds in the amount of \$1,216,376.00 have been voted and approved. The ease of marketing recent issues as compared to the problem of disposing of the original issue indicates the stability of the project and the confidence in the ability of those in charge of the project. The estimate of annual cost



Weir for measuring water discharged from main canal into lateral.

of normal operation, including bond interest, redemption and depreciation, etc., is \$213,180.00, or \$9.69 per acre per annum. County valuations are used for district assessments, the total assessed valuation for 1927-1928 being \$553,283.00. The selling price of land previous to the formation of the district was on an average \$40 per acre. Now land is selling from \$100 to \$200 per acre.

This man-made irrigation system, representing an investment of \$1,200,000, will ultimately require 5000 horsepower to lift the water to the various levels for distribution. The initial load will be about 2500 horsepower, which will be increased as additional land comes under irrigation.

Electrical service to a project of this magnitude commands prime consideration, as the successful and economic operation of the individual units depends upon constant and adequate speed and voltage. Various sources of supply must be available and ample stand-by service must be maintained to guard against power shortage during dry years.

Proposals for serving this important load had been made by Pacific Gas and Electric Company and the publicly controlled Modesto Irrigation Dis-



Junction of main canal and San Joaquin River, showing main water gate.

Clubs have their respective homes at Corinthian Island and Belvedere.

Tiburon is located nearby on the mainland and is the industrial section of the group. Here the principal activity is found at the Northwestern Pacific Railroad shops. The residents are practically all employees of the railroad company.

The installation of mains in Belvedere and Corinthian Island presented many difficult problems, as only small sections of the narrow steep and winding streets could be opened at any time without interfering with traffic. Damage to the lawns, shrubbery and terraced walls was carefully avoided, requiring slow and tedious work. Many of the residents commended the men for the respect which was shown the gardens and marveled at the success with which the service pipes were jacked under the retaining walls and shrubbery.

The residences are high class, applications for service came in promptly, and the number secured has exceeded expectations. The railroad shops and business section of Tiburon, nearby, offer opportunities for industrial



Gas plant at Salinas. Newly acquired property.

and restaurant service.

This extension was exceedingly satisfactory from both the manner in which it was made and the spirit in which it has been received by the communities.

The laying of the transmission line from Richvale, in Butte County, to Chico completes the plan of centralizing the production plant at Marysville and abandoning those at Oroville and Chico. Water-gas manufactured from coal and oil is now supplied from Marysville to Yuba City, Live Oak, Gridley, Biggs, Oroville and Chico. Such equipment in the Chico plant as was usable

was removed and installed in other plants. The gas storage holder, boosting equipment and pressure regulators are being utilized in the present operating scheme, and to this have been added new boosters, governors and a metering station.

The laying of this line presented a few unusual features. The route chosen was over the old county road, which involved difficult trenching



Monterey gas plant. Newly acquired property.

through about three miles of lava rock and seven miles of hard cement gravel, but the soil conditions as regards corrosion were much better than along the State Highway. Opening the ground along this ten-mile stretch of rock was accomplished by blasting with powder. The proximity of the road and presence of a 60,000 K.V. pole line complicated the situation somewhat. The drill holes were slightly inclined and placed about three feet apart along the line of the trench. In order to control accurately the time of shooting, the firing was done with electric caps and battery. By the use of a rheostat, it was possible to fire each hole singly and at such intervals as the traffic would permit.

An unexpected situation developed when heavy rain caused the Sacramento and Feather rivers to overflow and flood a large area through which the trench had been dug and where several long lengths of welded pipe line lay in place but were not covered as they were under test for leaks, by being pumped with air to ninety pounds pressure. With the rising water these sections promptly floated away. Although the flood occurred over a week-end, watchful eyes caught the situation and a prompt response to call for help resulted in the capture of the "float-aways." They were brought back, anchored in place over the trench into which they were automatically lowered by the receding of the water. Doubtless a rather difficult task might have developed had this not been discovered at the right time.

In spite of many delays and exceptional conditions, this 22½-mile line was completed in less than four months, being turned over for operation on May 1st, 1928. This was within the time allotted for the work. The



The gas plant at Eureka, Humboldt County.
Newly acquired property.

cost, also, was within the original estimate. This is an excellent illustration of how a construction crew, by being on its toes, can arise to the occasion when special conditions confront them.

The same crew also completed 16 miles of 16-inch high-pressure line on September 29th, 1928. October first was the date set for operation, so they again finished in scheduled time. This line was from the Potrero Gas Plant in San Francisco to the southern limits of San Bruno, tying into the Peninsula 8-inch high-pressure line. It was the first step in a new program toward increasing capacity of the entire peninsula transmission line which now extends to San Jose.

Gas is being supplied to the intervening territory from the two plants at the ends of the line. Originally, a 2-inch line ran only a short distance from San Francisco; this was replaced by a 4-inch and extended further, to be followed by an 8-inch line; later, the final tie-in with San Jose was made. Now the work of increasing the line to a 16-inch size has been started. The frequency with which other sections will be added depends upon the growth in this region. In the past ten years the development has been quite rapid and the indications point to a continuation at a greater speed.



Northwestern Pacific railroad shops at Tiburon, Marin County.

The construction program in the gas plants during 1928 consisted principally in a sort of general clean-up in some of the smaller plants. No major additions to the larger plants were required and the work in the others consisted principally in improvements and alterations rather than increase in generating capacity. Modern scrubbing, more gas purification equipment, better handling of waste water and improved boiler plant auxiliaries were the principal objectives.

The plant at Grass Valley, which supplies gas to the cities of Grass Valley and Nevada City, received a little more than the average amount of alterations and, as a result, was fairly well renovated. The old scrubbers, relief holder, air blowers, oil heaters, wash room and lampblack separators were replaced with new and a boiler, after-cooler, recirculating system, waste water filters and gas compressor were added. It now presents an acceptable appearance and improved operating results.

Research activities in the Gas Department were somewhat curtailed. On account of the approaching introduction of natural gas into the bay region, practically all of the studies of production problems were discontinued as the new plans completely change the methods of operation. Furthermore, the new problems which will be encountered are not as yet sufficiently definite to justify any extensive work based simply upon anticipation.



Corinthian Island, opposite Belvedere.

For a number of years, there has been conducted an intensive research into gas purification and by-product sulphur. The adaptability of this sulphur to commercial use has been definitely established and a demand for it has been created. The surplus sulphur that accumulated in the meantime has now been marketed. Inquiries for hydrocarbon sulphur are coming in from unexpected places. Over eighty carloads will be disposed of this season. It has proven its superior value for certain purposes, such as the protection of lettuce, melons, grapes, and orchard fruits, from fungus, mildew and mold. Now, however, the production is limited by the advent of natural gas.

A similar situation exists as regards benzol. It is a refined product from the condensate which drops out of manufactured gas in the after-coolers following the compressors. If it were not collected there it would condense in the high-pressure mains from which it must be pumped and hauled back to the plant. For a time during the past year a surplus of benzol accumulated,



The picturesque residence district of Belvedere, on the Marin shore of San Francisco Bay.

but this market has opened and it has moved twice as fast as at any time since its production was undertaken. This, too, will be somewhat curtailed with the coming of natural gas.

The disposal of the tar which is produced at the Marysville Plant is encouraging. There was a strong demand for such tar products as solvents, disinfectant oils, pitches and mixtures suitable for use in plants. The small experimental still was no longer capable of keeping up with the orders. It has been necessary to make arrangements with one of the oil companies to refine several carloads of tar. Indications are that the present output of the Marysville plant can satisfy but half of the present market in California. Since the bringing of natural gas into the bay region does not affect the operation of the plant at Marysville, production of tar will continue and will increase in amount in proportion to the growth of the communities served from that plant.

Considerable interest has been taken in gas-making tests with Shasta County coal, conducted at the Marysville Plant. This coal has many peculiar properties, but its possibilities for gas-making could not be estimated without a test run. A few carloads were shipped to Marysville where it was substituted for the coal regularly used. Certain mechanical difficulties as to draft and fire-cleaning developed, but it was felt that these can be eliminated by using some of the very recent improvements in water-gas

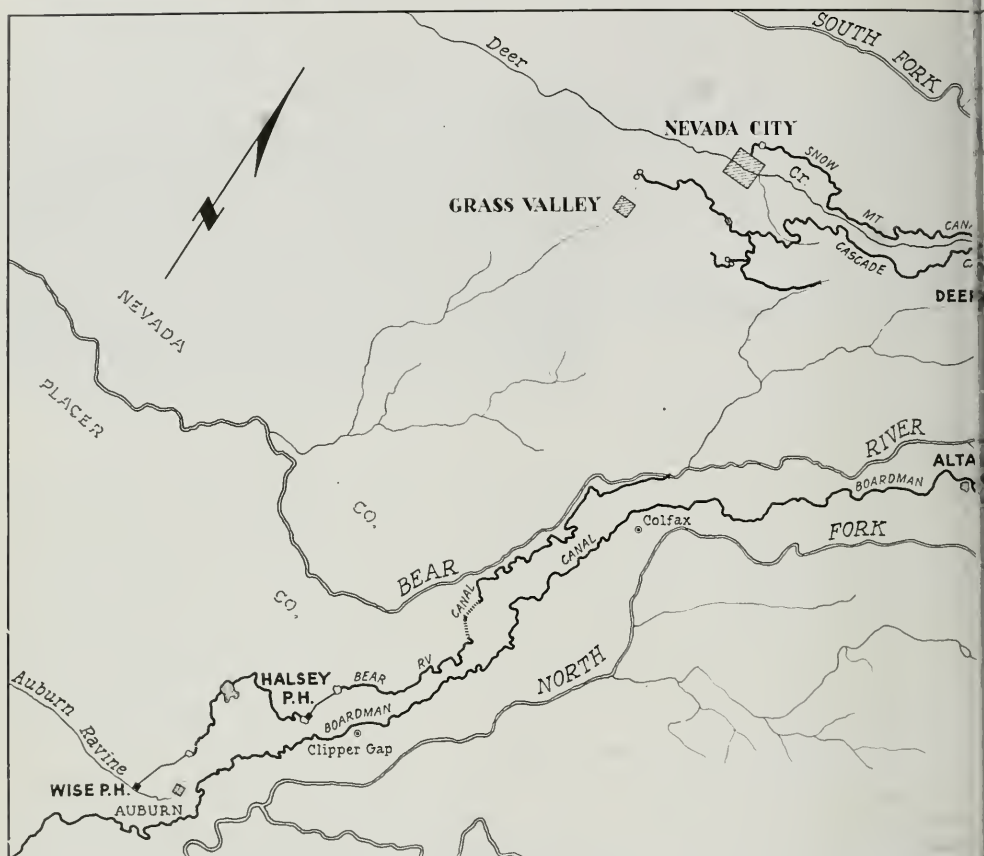


Gas in the Sierra Nevada. Grass Valley plant.

equipment which can be attached to the present generators. There is one objection which, as yet, has not been satisfactorily answered. The volatile matter of this coal contains large amounts of carbon dioxide, part of which appears in the finished gas as a dilutant and increases the specific gravity. However, should economic conditions become such that these mines can be operated on large tonnage, so that the mining costs can be brought to a normal figure, it is very likely that means can be found to use this coal for gas-making.

The foregoing features of Gas Department work during the past year stand out with special interest, largely because they differ from those of other years. Naturally, by far the greater expenditure of time and money throughout the system was involved in the regular routine of operation, maintenance, service work and expansion with the normal growth. The activities mentioned are not the milestones of growth but, rather, points of interest along the way.



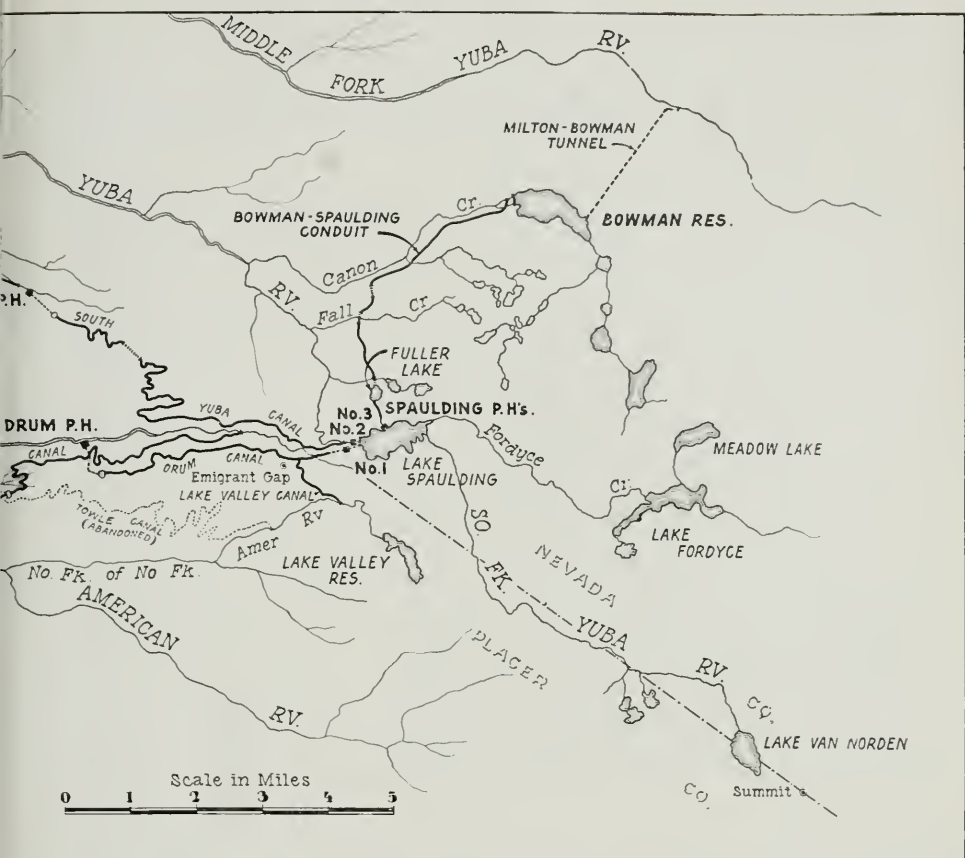


Map of our company's Drum-Spauldung water and power system in the Sierra Nevada

Under the heading "Enlarging Spaulding-Drum System — Co-operative Project at Completion," the October issue of *PACIFIC SERVICE MAGAZINE* contained an article descriptive of a major construction project recently completed in our company's South Yuba territory, through which "Pacific Service" is enabled to utilize water supplied by the Nevada Irrigation District from its developed resources on Canon Creek and the Middle Yuba river at points lying to the north of Lake Spaulding.

In the accompanying map the entire project is set forth. The irrigation district's main source of supply is Bowman reservoir, from which the water, contracted for to the maximum of 108,000 acre-feet annually, is conveyed by canal and tunnel to Spaulding.

The fall into the lake is utilized by our company for the operation of a new power plant, Spaulding No. 3, recently completed. Spaulding plants Nos. 1 and 2, below the dam, have been increased in generating capacity, and the carrying capacity of Drum canal has been enlarged from 350 to 500 second-feet capacity. From the lake the supply of district water is divided, 35,000 acre-feet annually being routed through Spaulding No. 2 plant and via the South Yuba canal to our company's power plant on Deer Creek, after which it is returned to the Nevada Irrigation District for distribution in its territory around the cities of Grass Valley and Nevada City. The remaining portion of the district's water, amounting to a maximum of 73,000 acre-feet annually, is



recently enlarged under a co-operative contract with the Nevada Irrigation District.

utilized first for the development of power at Spaulding No. 1, thence through Drum canal to Drum power-house. An amount estimated at from 12,000 to 15,000 acre-feet annually of the district's water may be utilized through Halsey and Wise plants, the remainder to be diverted by the irrigation district at a point near Bear River head dam for its own use further downstream.

A new feature of the company's development, as shown in the map, is the abandonment of 16½ miles of the old Towle canal from Lake Valley reservoir in the American River watershed. By the construction of a new conduit of flume and pipe Lake Valley water is now conveyed across the ridge to supplement the flow down Drum canal. The remaining portion of the Towle canal is now supplied from Drum canal.

It is estimated that the district's water used through the plants as at present constructed, together with the additional natural flow which can be utilized, will generate an annual output of electric energy amounting to, in round numbers, 190,000,000 kilowatt hours. Our company has agreed to pay the irrigation district for all water delivered under the terms of the co-operative contract referred to. Payments to the district will pay a substantial part of the interest and sinking fund requirements upon the bonds sold by the district to finance its construction outlay.

Co-operative contracts such as this one go far toward establishing relations of mutual benefit and understanding between the power and agricultural interests.

the outlook for 1929 promises an even greater proportional increase.

Gas is an ideal industrial and commercial fuel and its value as such is indicated by the fact that in 1928 our Company's industrial and commercial customers in East Bay Division used over \$850,000 worth of P. G. & E. gas. Among the largest consumers may be mentioned the National Lead Company, Chemical and Pigments Company, Sherwin-Williams Paint Company, Berkeley Brass Foundry Company, Edison Mazda Lamp Works, Standard Oil Company, Richmond General Engineering and Drydock Company, Moore Shipbuilding and Drydock Company, Hall-Scott Motor Company, Best Steel Casting Company.

Gas consumers in the San Francisco bay area will be materially benefited when natural gas piped from the San Joaquin Valley oil fields is placed at their disposal. While



Interior of 50th Avenue compressor station, which distributes gas to San Leandro, Hayward, and points south.

household consumers will be served a mixture of natural and artificial gas, large industries located close to the pipe lines which will pass through the principal industrial areas on both sides of the bay will be supplied with straight natural gas. Unusually low rates will be available to industries that can use gas at night and between times when there is not a great demand for household purposes. Domestic consumers will also profit. Natural gas has greater heating value than artificial gas, and the mixed product which the Company proposes to serve to domestic consumers will contain 700 heating units as against 550 carried by the artificial gas now being distributed.

With increased heating values and with the rate adjustments which the Company proposes to make, the aggregate saving to consumers in the San Francisco bay area is estimated at approximately \$2,000,000 annually.



Town of Niles, Alameda County.

Reduced Rates Prove Stimulus to Diversified Use of Commodities

By J. CHARLES JORDAN, *Manager Publicity Department*

The reduction of gas and electric rates to consumers of the company during the year 1928 was an outstanding accomplishment which, coupled with an aggressive sales campaign, resulted in the stimulation of the company's business.

These rate reductions in both gas and electric departments opened in March, 1928, with new lighting rate schedules. They made possible savings to consumers of approximately two and one-half million dollars in twelve months. Following these reduced lighting rates came the application of new combination domestic rates and new agricultural rates made effective in the territory served by the Pacific Gas and Electric Company and the Mt. Shasta Power Corporation. At the same time, a new set of rates similar to the P. G. and E. rates were made effective in the territory served by the California Telephone and Light Company, a subsidiary concern. In April, the Pacific Gas and Electric Company's lighting, combination domestic and agricultural power rates were also effective in Stockton and Sacramento divisions of the Western States Gas and Electric Company, recently acquired by purchase. In July, new lighting and combination domestic rates were made effective in the territory served by the Coast Valleys Gas and Electric Company, another recent acquisition, and in October the company's reduced rates were made effective in the Richmond Division of the former Western States Gas and Electric Company. In November, the territory formerly supplied by the Middle Yuba Hydro Electric Company was benefited by the application of the reduced rates. Immediately following the acquisition of the Tuolumne County Electric Power and Light Company and the Vacaville Water and Power Company and the McKinley Bros.' properties in Lake County, the reduced P. G. and E. rates were applied.

To fully acquaint our customers with the advantages to be derived from the application of the new and reduced domestic rates,

every customer affected was apprised of his opportunity through the distribution of a special notice which included detailed information as to when and how the new rates were to be applied. With these circulars was an application blank which the consumer filled out requesting the rate schedule which would be most beneficial in his particular case.

More than 424,000 individual notices were sent to consumers and many domestic consumers have already made application for the special combination domestic electric rates.

Concurrent with the mailing of notices and applications to the consumers, an advertising campaign was carried on through the newspapers in which large display space was used telling of the reductions and explaining that the reductions averaged 10 per cent, with an example showing that a customer who formerly paid \$2.40 per month for light would, under the new rates, pay \$2.15, or a saving of \$3.00 per year, more than one month's average bill.

Those consumers who would qualify for the domestic rates were advised that where the customer formerly paid \$3.30 he would, under the new rates, pay \$2.60, or a saving of \$8.40 a year, a reduction greater than two and a half months' bills under the former lighting rate. In the place of 90c-\$1.00-\$1.25 minimum charges there were put into effect small service charges of 40c, 50c or 70c, according to the territory served.

These advertisements also told how low these new rates were for heating and cooking, now as low as 1½ cents per kilowatt-hour. Consumers were invited to make electricity their household servant. "It is cheaper now—you can use more of it," was the slogan used, and the invitation was extended to our customers to let electricity brighten the gloomy corners, do the cooking, ironing, washing. They were told: "It will sweep the floors, operate the electric fan, drive away the chills. It will percolate the coffee, make the toast, keep the food clean and

wholesome, through the use of modern labor-saving devices obtainable through the local dealers or our offices."

This intensified advertising campaign in approximately 250 newspapers in the territory served by the company, with advertisements appearing each week, served as a background supporting the Sales Department's activities. Supplementing this newspaper advertising, posters were prepared and displayed in the company's several offices and newspaper stories were released and published in the papers throughout the P. G. & E. territory.

In addition to these marked reductions for lighting and domestic heating and cooking consumers, there were instituted new and reduced street lighting rates, bringing about a general downward revision for this class of service throughout the system. Municipalities were apprised of this reduction. Letters

were written by our division representatives to the local authorities, advising them that the reduced rates had been instituted by the Pacific Gas and Electric Company to encourage better lighting of streets and highways by the addition of more lamps and increasing the capacity of the existing street lighting installations. As a result, there appeared in the newspapers, from time to time, many favorable articles regarding the company's voluntary reductions.

Gas consumers came in for their share of benefits to be derived from the reduction of rates, resulting in a substantial saving to those consumers. These reductions came principally through the reduction of cost of oil used in the manufacture of gas.

As previously stated in this article, these general rate reductions made it possible for our gas and electric consumers to save approximately two and one-quarter million dollars in twelve months. The responsibility for the development of business to offset the consequent large reduction in the company's revenues was placed in the hands of the Sales Department. An intensive sales campaign was carried to a successful conclusion before the end of the year, resulting in such

marked stimulation and development of the company's business that it warranted the approval of a continuance of our sales program for the year 1929. This year the department expects to duplicate the million dollar sales campaign of 1928 with even greater results.

The development of a force to create enough business to offset the loss of revenue required the immediate increase of 60 per cent of the man power. There

were employed on January 1, 1928, 122 electric salesmen. This number was augmented to 197. The sales plans for the year were approved in February, and during that month 22 new salesmen were added, with other increases in man power until the department personnel was brought up to a full quota. Sales schools were held and active selling commenced by the new men. The company's management authorized bonuses and commissions to company employees for sales and prospects, and this, too, involved considerable educational work to acquaint them with the company's plans.

Employees greatly assisted during the year in making the final results possible. The year's sales activities were divided into seven

Pacific Gas and Electric Company Reduces Domestic Electric Rates!

On March 1, 1928, the Pacific Gas and Electric Company made a general reduction in the lighting rates which will result in an average saving of approximately 10% to lighting consumers.

In addition to this reduced lighting rate, a special reduced Combination Lighting, Heating and Cooking Rate will be available on April 1, 1928. The Combination Rate applies only to single family dwellings and to separately metered flats and apartments where the consumer uses lamp socket appliances of at least 1000 watts aggregate capacity in addition to lighting service.

The use of two or more lamp socket appliances such as percolators, irons, toasters, waffle irons, heaters or other similar electrical appliances will qualify you to receive the Combination Rate, a copy of which is printed on the reverse side of this notice for your information.

Attention is particularly directed to the fact that this Combination Schedule offers rates as low as $1\frac{1}{2}\phi$ per kilowatt hour, as may be observed from a study of the schedule.

The $3\frac{1}{2}\phi$ rate is available for electric energy used in excess of 30 kilowatt hours per month (\$1.90) for residences of six rooms or less. (Refer to Schedule for information concerning residences of more than six rooms.)

The Combination Rate was made available to encourage a more extensive use of electricity in the home and to promote the use of electric ranges, water heaters, air heaters and refrigerators.

Consumers using domestic electrical appliances aggregating 1000 watts or more, in addition to lighting service, may obtain the immediate benefit of the Combination Rate by properly filling out and returning the application form provided below.

The Combination Rate will be made effective on the next regular meter reading date after receipt of the application by the company.

The local office of the Pacific Gas and Electric Company will be pleased to supply additional information regarding rates and appliances on request.

PACIFIC GAS AND ELECTRIC COMPANY.

Sample of Notice Sent to Customers.

classifications: appliances, major and secondary, lighting, domestic and commercial, competition, street lighting, isolated plants, industrial electric heating, power extensions. In each of these classifications a quota was set and each contributed its proportion to the final success of the year's campaign.

The realization of the fact that united effort could bring about a considerable expansion of the industry in all its phases brought about the inauguration of a sales department activity during the year known as Dealer Co-operation. Through this bureau contacts were made with dealers and they were advised of the rate reductions and the advantages of these new rates to consumers and to themselves in promoting appliance sales. To help stimulate the sale of appliances by dealers, some 48,000 pamphlets entitled "What a Few Cents' Worth of Electricity Will Do for You Now with New Electric Rates" were distributed through dealers. This afforded an opportunity for dealers to sell appliances which would qualify the customer for the new and reduced rates.

Window display cards were distributed to all dealers and large window trim posters were placed in the leading electrical merchandise stores in San Francisco, Sacra-

mento, San Jose, and the eastbay cities.

In selling appliances as outlined under the extensive sales program, salesmen called personally at the homes of consumers and, in connection with the display of their merchandise, explained the new rate schedules and the advantages to be gained by their ap-

plication. This afforded a splendid opportunity for the introduction of the new rates and resulted in the sale of thousands of appliances.

Among the outstanding sales activities was the sale of 21,600 electric heaters. During the Hotpoint Range campaign of May and June, with a quota of 560 ranges, 1146 were sold. On the two classifications of appliances and lighting equipment, over one million dollars' worth of current-consuming devices were sold. Summing up all activities, there were some 242,204 kilowatts of new electric load added, with a revenue accomplishment of \$3,163,800.

While the reductions and ac-

tivities of the gas division of the Sales Department were not as large or spectacular as those of the electric, there was, nevertheless, a continuous and aggressive sales effort through which \$1,136,586 of new business was secured. The demand for gas as the ideal fuel grows in proportion as population increases and industries expand.

P · G · and E · Electric Rate Reduction

For Lighting NOW in Effect
New Domestic Rates in Effect April 1, 1928

**\$1,750,000.00
Saving**

Through the application of the new electric rates, customers of this Company will save over \$1,750,000.00 a year based on present use of electricity.

Average 10% Reduction

As for example in the metropolitan bay area, a customer who formerly paid \$2.40 a month will now pay \$2.15, or a saving of \$3.00 a year, or more than one month's bill.

Lighting Cheaper

The new lighting schedules go into effect automatically with the top or maximum rate greatly reduced.

Upon application from the domestic consumer qualifying, there is offered a new rate for combined use of light and heat or power.

Domestic Rate

Where domestic consumers have lighting service and in addition use electric ap-



pliances totaling 1000 watts or more capacity this new rate applies. In the bay area a domestic consumer formerly paying \$3.30 will now pay

\$2.60 a month, a saving of \$8.40 a year, or a reduction greater than two and a half months' bill under the former lighting rate—all territory will be reduced in similar proportion.

Old Minimum Charges Abolished

In place of the former 90c, \$1.00 or \$1.25 minimum charges there will now be a small service charge of 40c, 50c or 70c—in accordance with the territory served.

Heating and Cooking Rates as Low as 1½ Cents Per Kilowatt Hour

The new schedules provide attractive lower rates for this class of service and are designed to encourage a greater use of electricity. These rates are among the lowest obtainable anywhere.

Make Electricity Your Household Servant

Let it brighten the gloomy corners—do the cooking—ironing—washing. Let it sweep the floors—operate the electric fan—drive away the chills. It will percolate the coffee, make the toast, keep your food cool and wholesome. It will aid you in many ways through the use of the modern electric labor saving devices, obtainable through the local electrical dealers or our offices.

Our representative will be pleased to explain how a greater use can be made of your electric service through the application of these new rates.

Electricity is cheaper—you can use more of it

PACIFIC GAS AND ELECTRIC COMPANY

P · G · and E ·
Owned, Operated, Managed
by Consumers

Sample Advertisement Announcing New Rates.

Educational Courses for Employees— Technical and Business Instruction

Twelve years ago employees of the Pacific Gas and Electric Company founded the Pacific Service Employees Association for the purpose of bringing the employees together and creating a feeling of loyalty and goodfellowship. It has proven in every way a successful venture. Its present membership is approaching the 7500 mark.

Among the major activities of the Pacific Service Employees Association that go far toward promoting the employee's business efficiency is the educational work. It was in the year 1922 that several regular P. S. E. A. courses were established with the object of offering to the employees an opportunity for self-improvement. New courses were added from time to time to fill the needs of groups of employees, until now there are twenty courses available. The courses today include: Elements of Accounting; Accounting Practice; Business English; Business Correspondence; Arithmetic; Algebra; Geometry and Mensuration; Trigonometry; Commercial Electricity; Direct Current; Alternating Current; Switching Equipment and Power Control; Electric Distribution; Production of Oil Gas; Gas Distribution; Domestic Gas Appliances; Elements of Hydraulics; Steam Boilers; Steam Engines and Turbines; Automotive.

The Association's educational activities are unique in so far as they are carried on entirely by volunteers. No remuneration is received by any of the teachers. The students attend classes on their own time one day a week for a period of one hour and a half. The classes are usually held at the completion of the day's work. The work is carried on through educational committees of the various sections, there being thirteen sections in all. These local committees are under the supervision of the General Educational Committee, which is advised and assisted by an Educational Advisory Board, consisting of technical men and others holding responsible positions in the company.

A particular course, or a specific group of courses, is assigned to a member of the General Educational Committee who is required to prepare or revise the course, or

courses, as the case may be. If the work is involved, the member may call upon others outside of the committee to assist him. The men assigned to this work are all well qualified, and have had experience as class leaders. One member of the committee attends to the records, another to the final examinations, while still another, whose company duties require him to travel throughout the sections, contacts with the various section educational chairmen.

To give some idea of the personal time and effort given by the members of the General Educational Committee in charge of the preparation of courses, the member in charge of the Business Correspondence Course reviewed some thirty-two standard text books before recommending the one adopted. He then prepared a Class Leader's Guide and a Student's Manual in order that the work in the various sections would be uniformly maintained. To accomplish this he sacrificed his evenings and week-ends for a period of approximately three months.

When a class completes a course the students must pass an examination prepared by the General Educational Committee with a grade of 65 per cent before a certificate is issued. The object is to give all students a standard test. Experience had proved that when the first examinations were prepared by the individual class leaders, a student under one class leader would pass, whereas a student with equal knowledge under another class leader, who presented a more severe examination, would fail. Therefore, to standardize the examinations and with the object of giving all students an equal opportunity, it was decided that the General Educational Committee should prepare all of the final examinations.

Each section has an educational committee which is under the leadership of a chairman. The Section Educational Chairman must possess force, initiative and the ability to sell the educational plan to others and to keep up the interest and enthusiasm. He must be able to size up the prospective students and see that they are not placed in an advanced course without first acquiring the

necessary foundation. It is the duty of the local committee to carry on the enrollment work in their respective sections and to organize the students into classes. Each Sectional Committee has a secretary or clerk to receive the class leaders' reports and to compile the monthly statement, therefrom setting forth the section's educational activities. These statements are forwarded to the General Educational Committee.

The class leader is one of the most important factors of the educational work. Special attention is given by the Section Educational Chairmen to the appointment of class leaders inasmuch as the success of the work largely depends upon their sincere efforts to "put it over." Men possessing special training or a technical education are preferred. The class leaders are college men, former public school teachers or men who have completed P. S. E. A. courses.

The class leader profits by the work he does in assisting his fellow workers. It is said that one does not know a subject until he can successfully explain it to another. The teacher acquires more accurate knowledge of the subject matter of the course and acquires, in addition, a goodly measure of knowledge of human nature, and self-confidence, ease of manner and readiness of speech before an audience. The class leader can make much of this opportunity to better himself in these respects. With practice he develops his own teaching methods. There is a splendid opportunity for personal ingenuity in retaining the interest of students. He often deviates somewhat from the bare text, introducing experiments, or securing outside help in illustrating the point being discussed. Again, sometimes he takes a class to a station or a laboratory where the students get a practical demonstration of some of the principles involved.

Any employee of the company, whether a member of the Association or not, wishing to enroll in a course applies directly to the educational chairman of his section, who arranges for his enrollment. The students are organized into classes which range from three to forty members, each class having its own leader and time and place of meeting. Meetings are held at regular intervals not more than a week apart, and the courses are arranged to be covered in from twelve to sixteen weeks.

A small deposit by the student is required on each course. The deposit is refunded

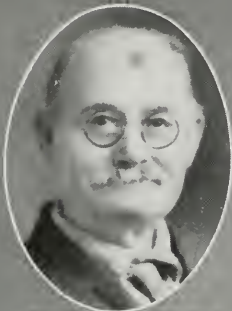
when the course is successfully completed; the Association absorbs the cost of the printed matter furnished. Standard text books which are also used by the public school departments are required in some courses, the Association absorbing part of their cost. Money collected for these books is not refunded, as the books remain the property of the student.

If a student is isolated and unable to join a class in the subject in which he is interested, provision is made through the section educational chairman for correspondence instruction. This is more difficult and not so satisfactory as class study, but the Educational Committee desires that the best possible opportunity be given to the member who is determined to improve himself.

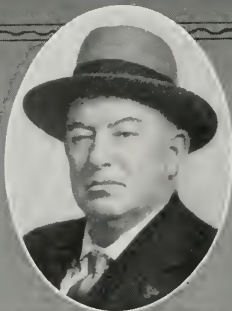
When a course has been completely covered, examination papers prepared by the General Educational Committee are passed out to the students. The papers are corrected and graded by the class leader, then checked by a member of the General Educational Committee. Records of class attendance and oral work are also kept and taken into consideration in the final grading. Certificates are awarded to students who satisfactorily complete any regular P. S. E. A. educational course. A record of the student's achievement is then forwarded to the Personnel Department of the company, where a notation is made on the employee's record. The chief value of a certificate, however, is in the satisfaction it gives to the recipient as a record of achievement. Its attainment indicates persistence and ability and marks a step completed in the student's self-improvement.

The Association's educational program offers an opportunity to gain a knowledge of various subjects. The technically educated man is given an opportunity to review the fundamentals of the subject offered. The text books serve as a valuable reference, as they contain the ground work of the sciences from which the Pacific Gas and Electric Company's business is built. Any knowledge which a man may acquire through the courses obviously makes of him a more intelligent workman.

A better understanding of the company's organization and structure is obtained by employees who meet in class rooms. The work brings employees together from various departments who ordinarily do not come in contact with one another.



John C. Miller



Philip S. Beel



William T. Lucas



Ed. P. Baggot



Patrick Finnegan



Walter C. Renfro



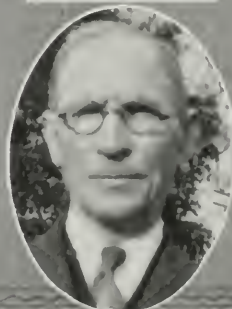
William C. Russell



Robert P. Craddock



George B. Baldwin



James Cruise

The "Pacific Service" honor roll. The above portraits are of ten former employees whose long and faithful service has earned them honorable retirement

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 99 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of ten portraits of our company's pensioners. These are:

Philip S. Beel. 72 years of age, having been born May 29, 1856. Entered the service of the Pacific Gas and Electric Company in October, 1912, and at the time of his retirement was employed in San Francisco Division.

John C. Miller. 71 years of age, having been born September 28, 1857. Entered the service of the Pacific Gas and Electric Company in June, 1913, and at the time of his retirement was employed in San Jose Division.

William T. Lucas. 70 years of age, having been born November 14, 1858. Entered the service of the Pacific Gas and Electric Company in May, 1913, and at the time of his retirement was employed in Sacramento Division.

Patrick Finnegan. 66 years of age, having been born February 23, 1863. Entered the service of the San Francisco Gas Light Company in December, 1888, and at the time of his retirement was employed in San Francisco Division.

Ed P. Baggot. 65 years of age, having been born May 29, 1863. Entered the service of the Oakland Gas Light and Heat Company in February, 1911, and at the time of his retirement was employed in East Bay Division.

Walter C. Renfro. 62 years of age, having been born May 26, 1866. Entered the service of the Sacramento Gas and Electric Company in March, 1901, and at the time of his retirement was employed in Sacramento Division.

Robert P. Craddock. 62 years of age, having been born October 9, 1866. Entered the service of the Sacramento Gas and Electric Company in June, 1900, and at the time of his retirement was employed in Sacramento Division.

William C. Russell. 50 years of age, having been born September 30, 1878. Entered the service of the Yuba Power Company in 1902, and at the time of his retirement was employed in North Bay Division.

James Cruise. 68 years of age, having been born December 25, 1860. Entered the service of the Metropolitan Light and Power Company in March, 1908, and at the time of his retirement was employed in San Francisco Division.

George B. Baldwin. 67 years of age, having been born July 1, 1861. Entered the service of the Pacific Gas and Electric Company in November, 1911, and at the time of his retirement was employed as special representative of the Publicity Department, General Office.

The Financial Side of "Pacific Service"

Ownership of the Pacific Gas and Electric Company is distributed among 53,197 stockholders, of whom 33,157 hold preferred and 20,040 hold common stock.

The number of preferred shareholders increased 2,651 since December 31, 1928, chiefly as a result of the "over-the-counter" sale of approximately \$5,000,000 par value of 5½% preferred stock early in 1929. There was also an increase of 1,478 common stockholders since the beginning of the current year, due probably in large measure to the purchase and exercise of "rights" under the Company's common stock Par Offering No. 4, no public offering of common stock having been made in this interval. Incidentally, subscriptions were received for 99.7% of the stock tendered under this par offering, less than one-third of one per cent of the stock offered remaining unsubscribed. This is a new record, each year since the Company's original par offering in 1926 having witnessed an increase in the ratio of subscriptions received in response to these offerings of rights.

Over four-fifths of the Company's stockholders are California residents, who number 43,143, or 81% of the total. The remaining 10,054 stockholders are scattered throughout the world. Not only are stockholders of the Company residing in every single state of the Union, but thirty-nine foreign countries are also represented, ranging from Japan to Jugoslavia and from Honduras to Siam.

Since the Company's initiation of the customer-ownership plan in 1914, upwards of 50,000 names have been added to its stockholders' registers. The extent to which this policy of home ownership was subsequently adopted by other utilities throughout the United States is indicated by the fact that in the past fifteen years the electric companies of the country, according to statistics compiled by the National Electric Light Association, sold \$1,880,000,000 worth of stock direct to 1,884,000 purchasers. A correspondingly wide distribution of stock ownership has been effected by other branches of the public utility industry.

The Company's stockholders include 20,329 men, 22,697 women, 8,654 joint tenants (usually husband and wife) and 1,517 associations, insurance companies and other institutions.

These figures reveal a continuation of the trend toward increasing stock ownership by women which has been noticeable during recent years.

At the beginning of 1914, there were only 900 women among the 2,959 names on the Company's registers. In the last three and one-half years alone there has been a net addition of 9,241, or 69%, in the number of women stockholders, compared with an increase of 5,655, or 39%, in the number of men. In the same interval there was an increase of 4,715, or 120%, in the number of joint tenants, of whom fully one-half are women.

Apropos of the gradual transition of the numerical preponderance of stock ownership in the Company from men to women, the following excerpts from a recent issue of *Coast Banker* are of interest:

"Whether women will have all the wealth of the country in their hands by 2025 is the arresting question raised by a study in statistics which comes from the mathematical moguls of Lawrence Stern & Co., Chicago.

"Of course," says the perspicacious commentator after adjusting his glasses in surprise at the results obtained by his own statistical department, 'no one believes that such a financial matriarchy is coming, but this calculation strikingly indicates the rapidity of the present trend.'

"The figures are the more surprising because the statisticians of trust companies have been telling us for some years that 80 per cent of the women who inherit money have none of it left after five years. Perhaps these are not just the figures, but they convey the idea fairly well.

"Analysis shows that 139 women paid taxes on incomes in excess of \$500,000 in 1926 and 44 on net incomes of more than \$1,000,000. On the other hand, individual returns of men showed that only 123 paid on net incomes of \$500,000, and 42 on incomes of \$1,000,000. Which goes to show that women are richer than men, we are told. But perhaps the women are not as adept in figuring deductions as men actively engaged in business.

"Many salient facts to indicate the financial power of women are revealed by the study. For example:

"Women are beneficiaries of 80 per cent of the \$95,000,000,000 of life insurance policies in force in the United States.

"Women pay taxes on more than three and a quarter billions of individual income annually.

"Women, by the thousands, are investing in stocks and bonds; collecting dividends and voting proxies.

"Women comprise the actual majority of stockholders in the largest corporations in America.

"Women constitute from 35 to 40 per cent of investment bond house customers.

"Women millionaires, as indicated by individual income tax returns, are as plentiful as men.

"Women are receiving 70 per cent of the estates left by men.

"Women are also receiving 64 per cent of the estates left by other women.

"Women to the number of more than 8,500,000 are gainfully employed.

"In any event, the commentator is overwhelmingly right when he says: 'The facts brought out indicate the necessity on the part of financial houses of gaining the confidence and good will of the potential feminine client if they expect to divert her very considerable funds into their offerings.'

"Today women comprise the majority of stockholders in our largest corporations. They comprise something over 50 per cent of the 454,596 stockholders of the American Telephone & Telegraph Co. In the United States Steel Corporation there are more than 50,000 women stockholders—over 50 per cent. Women also comprise 50.48 per cent of the shareholders of the Pennsylvania Railroad.

"Inquiry disclosed that from 35 to 40 per cent of the customers of leading investment bankers are women. One New York house has a branch office exclusively for women. It contains a complete quotation board and the only male persons permitted in the room are the two 'quotation boys.'

"It will be recalled that the Harkness estate of \$107,000,000 and the Moses Taylor estate of more than \$100,000,000 went to women. These estates were larger than those of John Jacob Astor, J. P. Morgan, William Rockefeller, Russell Sage or Henry Frick.

"Of course, it is possible to conceive of an Amazonian period of feminine predominance when women will want to keep their money to themselves and use it in their own way to run the business of the world, but most of us will agree with the commentator of Lawrence Stern & Co. that such an era in human affairs is not likely."



Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII APRIL, 1929 No. 8

The United States Geological Survey has recently made public its annual compilation of the developed water power of the United States, as of the first of the current year. From its summary, we gather the following information:

The total capacity of water wheels installed in water power plants of 100 horsepower or more in the United States on January 1, 1929, was 13,571,530 horsepower, an increase of 1,275,530 horsepower, or 10.4 per cent, during 1928. The increase in 1927 was only 575,000 horsepower. The gain in 1928 was therefore more than twice that during 1927.

The equipment in public utilities and municipal plants increased by 1,347,955 horsepower, while that installed in manufacturing plants declined by 72,425, this decrease being largely accounted for by various mills which ceased to function as industrial enterprises and became public utility power plants.

Interesting comparisons are afforded by a study of the details of the increases in total capacity in the various States. Maine, for instance, has remained practically stationary, in spite of the Fernald law, designed to encourage the development and use of water power at home. Maryland shows the largest increase, largely accounted for by the completion of the Conowingo project. California, North Carolina and Alabama show extraordinary growth in hydro-electric developments. In some of the States, the installation of water power has actually declined, largely as the result of the abandonment of numerous small, isolated plants and their replacement by service from widespread interconnected systems.

The California record for 1928 is set forth in a report issued by Mr. Frank E. Bonner, California representative of the Federal Power Commission and district engineer of the Forest Service at San Francisco. In this Mr. Bonner finds that the electrical industry of this State experienced a year of unprecedented expansion.

The output of the electric systems serving the State reached a total of eight billion kilowatt-hours, a gain of more than half a billion over 1927. This vast amount of energy represents almost ten per cent of the entire production of the United States, and was exceeded only by the State of New York. Although streamflow was somewhat below normal in 1928, the great storage reservoirs constructed in recent years provided dependable water supplies which permitted practically 90 per cent of the State's requirements to be met by water-power plants. In the production of hydro-electric energy California easily leads all other States.

An extensive construction program is constantly under way providing increased facilities to keep pace with the rapidly mounting demand for electric power and the report discloses that the new generating capacity brought to completion during 1929 aggregates 610,000 horsepower, which far exceeds the increase of any previous year. The largest amount of capacity added in the past occurred in 1925, when new plants with 370,000 horsepower were completed. The new plants placed in service during 1928 represent a capital investment of approximately \$60,000,000 and have aggregate capacity more than half as great as that proposed at the gigantic Boulder Canyon dam recently authorized by Congress.

The new generating facilities comprise 295,000 horsepower in water-power plants, and 315,000 in steam plants. Twenty-eight applications covering proposed new projects in California were filed with the Federal Power Commission during the year, bringing the cumulative total of California applications up to 261. These have led to the issuance of 126 licenses by the Commission, authorizing the installment of 2,137,000 horsepower.

Mr. Bonner has recently completed an investigation of the hydro-electric power resources of our State, including a comprehensive survey of all the practicable water-power sites. The result is found in a report

published early this year by the Federal Power Commission. In this the statement is made that although the water-power plants of California are already producing more than 20 per cent of the hydro-electric energy of the United States, the mountain streams of the State may be further developed to multiply the capacity fivefold.

The report demonstrates that California is endowed with feasible sites for increasing the present installation of 2,000,000 horsepower to a total of 10,000,000 horsepower; thus assuring, for many years, a continuance of the cheap and dependable electric power supply which has been a fundamental factor in the amazing industrial and agricultural development of the State. With aggregate capacity of 10,000,000 horsepower installed eventually, it is estimated that a continuous output of 6,080,000 horsepower may be maintained.

Due to the unusual physiographic characteristics of California, nearly 90 per cent of the State's waters originate in the limited mountainous regions along the north Pacific slope and those surrounding the Sacramento-San Joaquin valley. It thus develops that the major water-power resources are concentrated in the Klamath basin and the Sierra Nevada region.

The report provides a detailed forecast of the future growth of population and electric load in the State, and estimates that with an increase from the present population of about 5,000,000 to 12,000,000 in the year 1960, the consumption of energy will have increased to thirty billion kilowatt-hours a year. Measuring such demand against the available resources the report states: "From the forecast of probable growth of the California load, and on the assumption that about 80 per cent of the future demand will be met by hydro-generated energy, it seems reasonable to conclude that full utilization of the available water powers of California will not be reached until well along toward the end of the present century."

The greatest expansion in the gas industry in 1928 took place in the natural gas fields, the estimated increase in production being about 10 per cent over 1927, while the increase in the output of manufactured gas was about 2.3 per cent, according to a report based on data supplied by the American Gas Association.

Total production of gas reached a new high record of 2,000,000,000 cubic feet, while sales and gross revenues also exceeded any ever previously reported in a single year.

There was a continued growth in investments in the gas industry, the total at the end of 1928 being \$4,750,000,000, compared with \$4,350,000,000 at the close of 1927. Investment in manufactured gas plants increased from \$2,700,000,000 to \$3,000,000,000, while that in natural gas systems rose from \$1,650,000,000 to \$1,750,000,000.

"During the last 24 years, marking the greatest expansion in the electric power and light industry, consumption of manufactured gas increased 329 per cent, from 114,000,000,000 cubic feet in 1904 to an estimated total of 490,000,000,000 cubic feet in 1928," the report says. "Development of natural gas also has been most important during practically the same period, this being indicated in a 331 per cent increase in production, from 338,842,562,000 cubic feet in 1906 to an estimated total output in 1928 of 1,459,882,000,000 cubic feet.

"Total revenues of the gas industry accruing from the sales of both manufactured and natural gas are estimated at about \$860,000,000 for 1928, compared with \$819,000,000 in 1927 and \$785,000,000 in 1926. Of the total operating revenues, \$519,000,000 accrued from the sales made by the manufactured gas industry, compared with \$501,000,000 in the preceding year.

"Continued growth and development, and expansion into new and wider fields, are regarded by gas executives as being ahead of their industry. To a greater extent than ever before the needs of the future are being anticipated and in every way possible all departments of the gas industry are keeping step with the economic changes of the times."

A measure of appreciation of what it costs to keep a comprehensive system like that of "Pacific Service" in constant repair and, at the same time, supply additions and betterments of service facilities to meet present and prospective needs may be gained from a perusal of our company's estimated expenditures for 1929.

The total amount appropriated for use is \$29,966,854, and this is distributed among the thirteen geographical divisions of our "Pacific Service" territory.

San Francisco division heads the list with an appropriation of \$7,661,330. The largest item on the list of proposed expenditures is one of \$3,500,000 for equipment to be purchased and preliminary work to be done at Station "A," the company's great steam-electric plant at the Potrero in San Francisco. This work, when completed, will, according to present plans, increase the installed electric generating capacity of the station from its present rating of 85,791 horsepower to one of approximately 300,000 horsepower. It is a five-year job and will cost, altogether, in the neighborhood of \$11,000,000. The balance of the money appropriated for the division this year will be expended in betterments and extensions of gas and electric service facilities, including reconstruction and replacement of gas mains and distribution lines, new service installations, new buildings, etc.

East Bay division, which takes in Alameda and Contra Costa Counties, is awarded an appropriation of \$4,186,018. This division is expanding rapidly, particularly in the industrial line, and it is in constant need of new construction work to take care of the increasing demand for both gas and electric service.

San Joaquin division is awarded \$4,282,325. Salt Springs development, on the Mokelumne River, lies within the confines of this division, and a sum of \$2,000,000 is set aside to cover construction work to be carried on there during the present year.

North Bay division is down for \$2,026,337. Some important reconstruction work is to be undertaken in this division, and there will be the usual activity in the way of enlarging and improving service facilities to rapidly growing communities, such as San Rafael, Santa Rosa, Petaluma, Napa and Vallejo.

San Jose division, taking in San Mateo, Santa Clara and portions of Santa Cruz and San Benito Counties, is awarded an expenditure of \$2,008,652. Important items in the work scheduled include the reconstruction of the Davenport transmission lines from Mountain View substation, construction of a 110,000-volt double-circuit steel-tower line from Morgan Hill to Gilroy (continuing that already constructed to Morgan Hill from Newark), a new substation at Meridian Corners and additions to the substation capacity at San Jose and San Mateo.

Sacramento division will expend \$1,848,-

995. Of this \$115,000 will be spent upon enlarging and improving El Dorado canal, on the American River, and \$110,000 on a new substation at Sacramento.

Drum division is awarded \$1,453,944. Of this it is proposed to expend \$800,000 on the enlargement of Bear River canal and \$225,000 for similar work on Wise canal. These pieces of reconstruction are made necessary by the recent increased water supply from the enlargement of the Spaulding-Drum system in the Sierra Nevada region.

Other divisions on the list include Colgate, with \$688,330; Coast Valleys, \$645,082; Shasta, \$501,280; de Sabla, \$365,302; Fresno, \$493,700, and Humboldt, \$132,000.

A public service corporation is a public servant. It must be ready when the public calls.

Another municipal power project has gone by the boards. For the second time in twelve months the people of Santa Cruz have voted to reject proposals to dam the San Lorenzo River for the construction of a municipal light and power plant.

Press comments generally uphold the decision of the electors. "The people won the greatest battle in the history of Santa Cruz" is the comment of the *Santa Cruz Herald*.

"In theory, the idea of political ownership and operation seems plausible; but it fails in practice," said Henry Ford recently, according to an interview in the *Electrical World*.

"Private enterprise is the road on which progress travels; that is, if any enterprise may be called 'private.' Progress is personal effort personally applied for personal good. Somehow, politically controlled and operated enterprises have not been able to draw out this kind of personal effort.

"Disillusionment awaits the government that would undertake the business of generating, transmitting and distributing electric power. The reason is simple—a government is not built for that purpose.

"We may be sure that any opposition to industrial advancement made by men who see political advantage in it will fail to recommend itself to the common sense of the American people. The record of electricity supply in the United States is one of continuously better service at continually lower rates. I believe that record can be maintained and will be maintained by the men who made it, not by political meddlers."

OUTSTANDING FEATURES OF "PACIFIC SERVICE"

PACIFIC GAS & ELECTRIC COMPANY

A California Corporation

Managed by Californians

Operated by Californians

"PACIFIC SERVICE" REPRESENTS (AS OF DECEMBER 31, 1928)

- 9,370 employed in all departments.
- \$375,000,000 capital invested in gas, electricity, street railway, steam and water plants.
- 61,000 square miles of territory in which it operates—an area greater than that of England and Wales.
- 49,000 stockholders.
- 38 counties of the state in which it transacts business.
- 1,004,340 consumers served with gas, electricity, water and steam.
- 2,500,000 people in 38 counties, which is approximately 50 per cent of the State population.
- 353 cities and towns in which it supplies service directly and through other companies.
- \$17,599,562 annual wages paid employees, year ending December 31, 1928.
- \$6,419,673 taxes, Federal, state, county and local, year ending December 31, 1928.
- 654,055 horsepower developed in 32 electric water-power plants.
- 244,470 horsepower developed in 9 electric steam plants.
- 898,525 total horsepower developed in 41 plants.
- 1,765,767,000 kw. hrs. sold, year ending December 31, 1928. This is equivalent to the effort of 5,885,890 men.
- 21,058,369,000 cubic feet of gas sold, year ending December 31, 1928.
- 19 gas plants.
- 18,367 miles of transmission and distribution lines. Nearly three-quarters of the distance around the earth.
- 5,227 miles of mains used in distributing gas. Greater than the distance between San Francisco and Oslo, Norway.
- 897 miles of mains and ditches used in distributing water.
- 1,300 miles of track of railway supplied with electric power.
- 94,977,913,360 gallons of water storage capacity of 104 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for approximately 5 years.
- 144,434 acres of land owned in California.
- 419 parcels of property owned in cities and towns.
- 4,781,025 barrels of California Oil used, year ending December 31, 1928.
- 266,651 horsepower in agricultural motors depending on "Pacific Service."
- 825,377 horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."
- 52,521 street lamps, gas and electric, lighted by "Pacific Service."
- 10,231,738 incandescent lamps nightly lighted.
- 2,129,860 horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

General Office: 245 Market Street
San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



*Pacific Gas and Electric Company's
General Office Building, San Francisco*

It Would Take a Hundred Buildings Like This

to accommodate the

Hundred Thousand
Investors

in the

BONDS AND STOCKS

of the

Pacific Gas and Electric Company

Every one of these numerous holders
of this Company's securities is
receiving a regular income
from his investment.

The Company's FIRST AND REFUNDING MORTGAGE BONDS FIRST PREFERRED STOCK COMMON STOCK

afford desirable mediums of investment in one of the largest and
soundest of the nation's public service institutions, which, with its
predecessors in title, has a record of three-quarters of a century of
successful operation.

RECORD OF RECENT GROWTH

	Gross Operating Revenue	Number of Customers	Sales of Electricity (K.W.H.)	Sales of Gas (Cu. Ft.)
1923.....	\$39,321,535	710,034	1,199,063,000	13,674,794,000
1924.....	44,451,586	763,617	1,334,035,000	15,277,478,000
1925.....	47,729,079	813,698	1,351,798,000	16,200,951,000
1926.....	50,960,571	874,724	1,514,981,000	17,482,206,000
1927.....	54,719,227	967,717	1,657,965,000	20,214,834,000
1928.....	61,449,592	1,004,340	1,765,767,000	21,058,369,000

Pacific Gas and Electric Company

245 Market Street, San Francisco

PACIFIC SERVICE MAGAZINE



MOKELUMNE RIVER CANYON
BELOW
SALT SPRINGS DEVELOPMENT

W JULY 1929 S

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Pacific Service Magazine

Volume XVII

Number 9

Contents for July, 1929



PORTRAIT OF MR. P. M. DOWNING	Frontispiece
OUR COMPANY'S NEW GENERAL MANAGER	267
MAP OF GAS TRANSMISSION SYSTEMS	268
NATURAL GAS SERVED TO CONSUMERS IN THE SAN FRANCISCO BAY AREA W. S. Yard	269
OUR NEWLY ACQUIRED PROPERTIES— CALIFORNIA TELEPHONE & LIGHT CO.	275
"PACIFIC SERVICE" AND AGRICULTURE— FRUIT FARMING IN SALINAS VALLEY J. F. Pollard	284
PROGRESS OF SALT SPRINGS PROJECT— BIG DAM ONE-QUARTER CONSTRUCTED	289
THE FINANCIAL SIDE OF "PACIFIC SERVICE" A. F. H.	292
EDITORIAL	294



Paul Milton Downing, elected First Vice-President and General Manager to succeed Frank A. Leach, Jr., resigned.

PACIFIC SERVICE MAGAZINE

Volume XVII

JULY, 1929

Number 9

Our Company's New General Manager

The Board of Directors of Pacific Gas and Electric Company at a meeting held July 17th elected Paul Milton Downing First Vice-President and General Manager to succeed Frank A. Leach, Jr., resigned.

The story of Mr. Downing's career is one of persistent diligence, backed by unusual capability. He was born in Newark, Missouri, November 27, 1873. After passing through grammar school he attended Washington College, from which he graduated in 1891 with the degree of B. S. Thereafter he entered Stanford University and studied electrical engineering. He graduated in 1895 with the degree of A. B.

His first employment was with the Tacoma Light and Power Company as dynamo tender. He had held that position but a short while when he was called to San Francisco to become assistant motor inspector and power-house operator for the Market Street Railway Company. This position he held during 1896 and 1897. Then he entered the service of the Blue Lakes Water Company as superintendent of its power-house at Blue Lakes City. This was one of the earliest hydro-electric plants operated in California. In 1898 he became associated with the late John Martin, who at that time was agent for the Stanley Electric Manufacturing Company, in the installation and operation of electrical apparatus. In 1900 he became chief electrician for the Standard Consolidated Mining Company at Bodie, California.

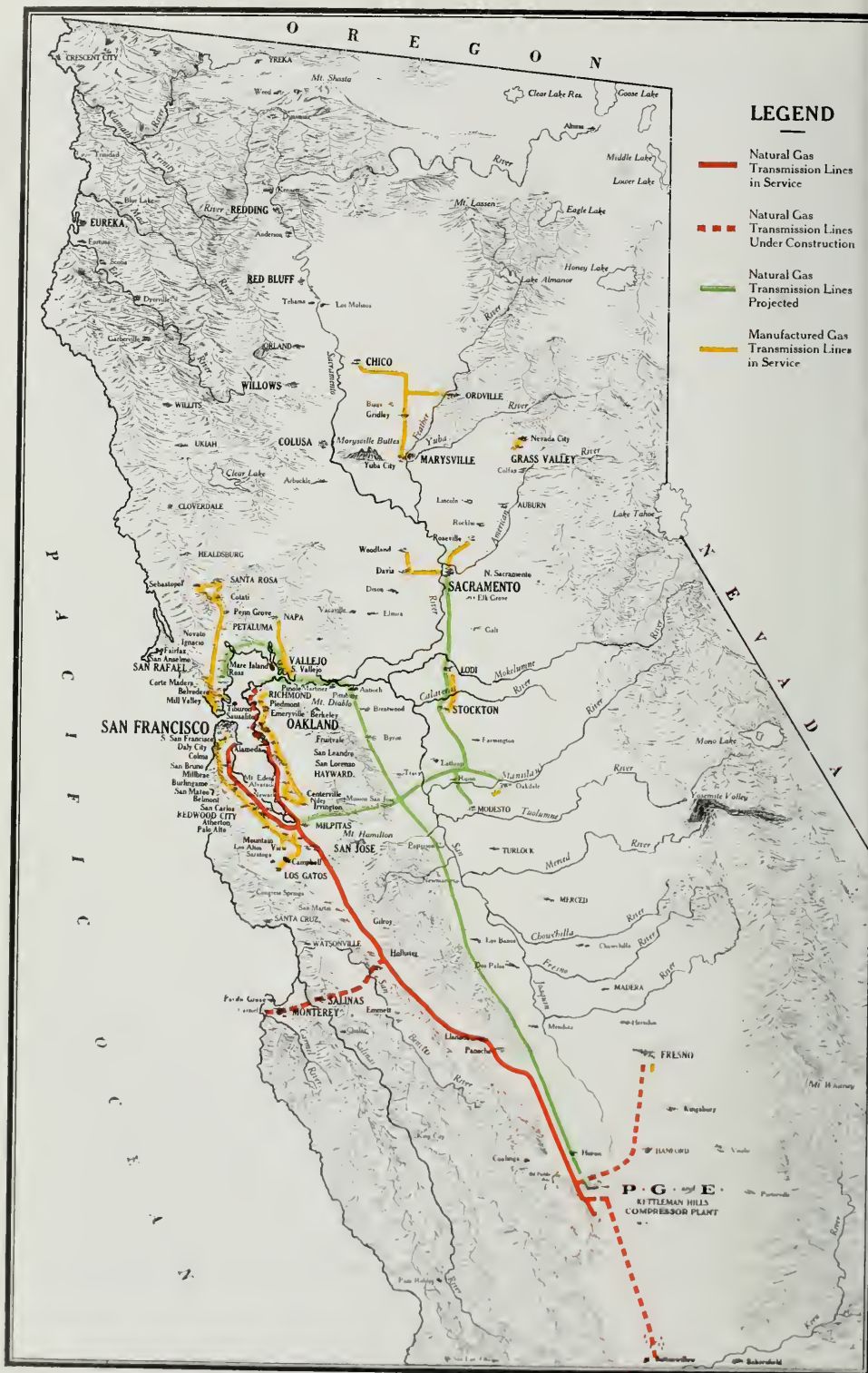
The following year he became manager of the Colusa Gas and Electric Company. He installed its electric distribution system, rebuilt its gas works and managed both branches of the business. In 1902 he was made division superintendent of the Bay Counties Power Company at San Francisco, and in 1903, that concern having been merged in the California Gas and Electric Corporation, he was appointed superintendent of substations and operating engineer of the major enterprise. Then, when the California Gas and Electric Corporation merged with the San Francisco Gas and Electric Company and Pacific Gas and Electric Company sprang into being, his field of activity was considerably enlarged. In 1908 he became Engineer of Operation and Maintenance, in 1917 Chief Engineer of the Electric Department, in 1920 Vice-President in Charge of Electrical Operation and shortly thereafter Vice-President in charge of Electrical Construction and Operation, from which position he now retires to assume executive charge of the entire operating system of "Pacific Service."

He is a member of the A. I. E. E. and was vice-president of the eighth district in 1927. Last year he was elected President of the Pacific Coast Electrical Association and in that capacity presided at the 13th annual convention of the Association held at Del Monte last June. He is a member of the permanent committee of the World's Engineering Congress, a member of the United States Chamber of Commerce, the San Francisco Chamber of Commerce, the Commonwealth Club and the Engineers' Club.

During his college career Mr. Downing was active in athletics. He played on the Stanford football team for four years and was captain of the team in 1894. Incidentally, Herbert Hoover was treasurer. Mr. Downing also played on the baseball team. He is in his third year as President of the Stanford Alumni Association. He is a director of the Olympic Club in San Francisco. His present outdoor recreation is golf.

In 1897 Mr. Downing married Miss Frances Stevenson. Their daughter, Margaret, is the wife of Hector Keesling of the Department of Electrical Construction.

He comes to his new executive position thoroughly equipped, in both experience and ability, for the work before him. He is extremely popular. He is assured of the loyalty and co-operation of the entire working organization of the P. G. and E.



Map of "Pacific Service" gas transmission lines, in service, under construction and projected.

Natural Gas Arrives on Schedule in the San Francisco Bay Area

By WILLIS S. YARD, Vice-President in Charge of Gas Construction and Operation

The first natural gas delivered in the San Francisco Bay area arrived at the Potrero Gas Works, San Francisco, at 5:30 P. M., August 16th, the company thus keeping its promise to have natural gas in San Francisco by the middle of August.

Gas is being received from the Kettleman Hills oil fields through the new 20-inch transmission line to the Milpitas metering station and from there dispatched to the branch lines to Gas Station "B," Oakland, and the Potrero Gas Works in San Francisco. The placing in operation of this pipe line completes the first unit of 231 miles in the P. G. & E. program for the serving of natural gas in Central and Northern California. The construction of 55 miles of 16-inch line between Kettleman Hills and Buttonwillow is well under way, and completion is expected before November 1st. Gas supplied at the present time is coming

entirely from the Kettleman Hills field, and upon completion of the line connecting with Buttonwillow, the gas wells in the Buttonwillow field will be connected to the main transmission system, providing an additional gas supply.

The branch lines from Milpitas to Oakland and to San Francisco were constructed by P. G. & E. employees, the main line from Milpitas to Kettleman Hills and to Buttonwillow being laid by contract, under Pacific Gas and Electric Company supervision. The entire line is welded into a continuous tube. The oxy-acetylene welding process was used, except in one short section of 15 miles, where electric welding was employed.

Special care was taken to protect the pipe lines against corrosion, due to bad soil conditions. Some sections of the line are covered with two layers of protective paper in addition to the regular asphaltum paint. Special

welding inspectors were employed to supervise all welding operations, and we believe that the welding job is as near perfect as it is possible to obtain, as no leaks of any consequence developed upon placing the line into operation. Valves have been placed in the line at five-mile intervals in the valley sections and at two-mile intervals through the mountains. Special valves have been installed where any particular hazard is thought to exist.

The Kettleman Hills oil fields are said to be the largest potential gas and oil fields discovered in California, and it is from this area that the Pacific Gas and Electric Company expects to draw its main gas



Pipe manufactured at the Western Pipe and Steel Co.'s plant, South San Francisco.

supply for many years to come. At the present time, gas is being taken from the famous Elliott No. 1, well, of the Milham Company, and also from the Standard Oil Company's No. 81. Several wells are nearing completion. One well at the present time is out of control and delivering approximately one hundred million feet of gas a day to the air. Present indications are that a plentiful supply of gas will be available as the market is developed and that the field will continue to produce for a great many years. The producing wells in this field are practically 7000 feet deep and the tremendous gas pressures encountered make drilling exceedingly difficult and expensive, so that development can only be carried on by large responsible companies. This all adds to the life of the field and assures Northern California a natural gas supply for many years to come.

The gas produced in this field is a wet gas and is passed through an absorption plant for the removal of the gasoline before the gas is delivered to the pipe line at 400 lbs. pressure for transportation to the San Francisco Bay district. The heating value of this gas as shown by our calorimeter tests at

Potrero are in excess of 1170 British thermal units.

In addition to the Kettleman Hills gas supply, the company has an additional gas reserve in the Buttonwillow field, about sixty miles southeast of the present producing wells in the Kettleman area. Seven gas wells have been completed in this field and stand capped at 1050 lbs. pressure. Tests indicate these wells can each produce in excess of 10,000,000 cubic feet daily. The gas in the Buttonwillow area is a dry gas, no oil or gasoline being produced from these wells. The heating content of the gas averages between 1050 to 1075 B. T. U. per cubic foot. The 16-inch line now being laid from Kettleman Hills to this field will deliver from 50,000,000 to 60,000,000 cubic feet of gas per day to the Kettleman Hills compressor plant now under construction at the terminus of the 22-inch line. It will be necessary to recompress this gas to approximately 400 lbs. pressure in order to make delivery at Milpitas at the necessary pressure to supply San Francisco and Oakland. The compressor plant will be completed about November 1st and in readiness for operation in the event it is desired to take gas from the Buttonwillow gas wells.

Five large gas-driven compressors are being in-



Laying pipe along the highway near Belmont, San Mateo County.



Barging pipe at South San Francisco for conveyance to Alviso for the Oakland line.

stalled at Kettleman compressor station, each having a daily delivery capacity of 14,000,000 cubic feet at 400 lbs. pressure. A small city is being built at this location, as it will be the headquarters of field operations. Cottages are being constructed with all the conveniences of city homes, including gas service and electric refrigerators, and everything is being done to make our employees contented and comfortable.

At the present time natural gas is being sold to industrial plants located near the main transmission line and the Pacific Gas and Electric Company is using 30,000,000 cubic feet per day in its gas operations and as boiler fuel in its steam electric generating plants at Station "A," San Francisco, and at Station "C," Oakland. The construction program in the gas plants had been co-ordinated with the pipe-line schedule, so that within one hour after the gas had been received in San Francisco it was being used in the manufacture of gas for distribution to domestic consumers. A few hours later gas was being used to replace oil in electric generating Station "A." Within two days after the arrival of the natural gas, 90 per cent of the gas supplied the Bay area was being manufactured from the natural gas, which had replaced oil in the generators. Many contracts are being signed by industrial gas consumers and as soon as proper connections can be made to supply these plants, service will be rendered.

Construction work is under way on a gas line starting from the 20-inch trunk line near Hollister by way of San Juan and Salinas to Monterey, to serve the Monterey peninsula territory with natural gas. This service will also be extended to include Carmel, which is not served with gas at the present time. This line will be completed in November or early December. Plans have also been completed to supply natural gas to Fresno and it is expected to have natural gas service available in November.

Our program contemplated the serving of 700 B. T. U. gas to consumers in the Bay area immediately upon the completion of the gas transmission line from Kettleman Hills. This program assumed that a sufficient number of gas wells would have been completed by the middle of August to assure a satisfactory gas supply. Due to difficulty encountered in drilling these deep wells, it has been necessary to delay the serving of 700 B. T. U. gas in San Francisco and Oak-



A steep cut, South San Francisco.

land until the Buttonwillow line is completed, about November 1st. The present plans now under way for the San Francisco Bay area propose the serving of 700 B. T. U. mixed gas in San Francisco and Oakland not later than November 1st and the serving of natural gas to San Jose and all the cities and towns on the Peninsula up to the San Francisco-Daly City boundary line. Natural gas will also be served to the cities and communities on the east side of the bay, from Milpitas to the southern city limits of San Leandro. This program has been adopted after full discussion with the State Railroad Commission engineers of all the problems involved in the changing of the quality of gas supplied to approximately 400,000 gas consumers. Five hundred men are being trained and divided into special crews to make the necessary changes and adjustments to consumers' appliances, in order that they may enjoy maximum efficiency from the new quality of the gas.

We have given considerable study to the possibility of serving natural gas instead of the 700 B. T. U. gas in the San Francisco and Oakland metropolitan area this fall, but it will be late next spring before the necessary work can be completed to assure this important area an uninterrupted natural gas supply and make possible the serving of natural gas to all consumers in San Francisco, Oakland, San Jose territories. Until that time 700 B. T. U. gas will be of considerable benefit to the consumers now being supplied a present manufactured gas of 550 B. T. U. Two large holders are now under construction. An eight million cubic foot holder in Oakland and a ten million cubic foot holder in San Francisco will be completed early in November. These holders will be used for the storage of natural gas and assure supply to the consumers to be served natural gas at this time. The gas storage capacity of the entire Bay area would not be sufficient to guarantee straight natural gas service at this time to San Francisco and Oakland in the event of a line break or interruption in gas supply which would require more than twenty-four hours to repair. For that reason, it seems advisable to carry out the program as outlined above. To put this plan into effect will require the adjustment of all appliances in San Francisco and Oakland to burn 700 B. T. U. gas, and next spring these appliances will require changes and adjustments in order to burn the natural gas. In the territory to be converted to natural gas at this time appliances will be adjusted at once, making the change from 550 B. T. U. gas to straight natural gas.

In order to supply 700 B. T. U. gas to



A long trench near South San Francisco.

San Francisco and Oakland many changes have been made to the gas-manufacturing plants. Automatic mixing devices have been installed to control the heating value of the gas. Natural gas pipe lines have been connected to the oil-gas generators and gas is being used instead of oil at the present time for the manufacture of the gas being supplied the Bay area. Before the natural gas arrived, oil was sprayed into the generators and with the proper amounts of steam and the correct heat conditions an oil-gas of 550

B. T. U. quality was produced. With the introduction of the natural gas at the gas works, natural gas is now injected into the generators instead of oil, and under proper temperature conditions and the correct proportion of steam a changed or "reformed" gas is produced similar to the 550 B. T. U. oil gas. This permits the utilization of the natural gas at the present time without the changing of consumers' burners. The reforming of the natural



Laying pipe near Centerville, Alameda County.

gas is a highly efficient operation and under strict control, so that very few B. T. U.'s. are lost in the process. In the production of the 700 B. T. U. gas to be served in Oakland and San Francisco, a 550 B. T. U. gas will be produced from the natural gas and sufficient natural gas of 1150 B. T. U. will be added to the 550 reformed gas to maintain an average heating value of 700 B. T. U.

It was mentioned earlier in this article that the completion of the gas line from Kettleman Hills to Milpitas was the first step in the Pacific Gas and Electric Company's program to serve natural gas to central and northern California. The next step is the proposal to build another large transmission line to be known as the Valley line, starting at the Kettleman compressor plant and extending north by way of Tracy, through Contra Costa County to Richmond; also, a branch line extending west from a point near Tracy through Livermore Valley to Milpitas, tying into the present natural gas system. In addition, a line will be laid east from the junction point near Tracy to supply Modesto and continue north to Stockton, Lodi and Sacramento. This will provide a complete loop system and an independent source of supply of natural gas from the fields to the San Francisco Bay area. At a future date, it is also planned to tap this line near Crockett and lay a transmission line across the Carquinez Bridge to Vallejo and by way of Black Point cut-off to



Purging the line near Milpitas.

the San Rafael-Petaluma transmission line. This will supply natural gas to practically all the cities and towns of northern and central California, and provide a market for the natural gas which will be produced in the development of the Kettleman Hills oil fields.

The Railroad Commission has just granted a certificate of convenience and necessity for the construction of this proposed transmission system. Surveys are nearly completed, rights-of-way are being purchased and within a very short time construction work will be under way. Completion date is expected some time next spring and upon the placing of this project into operation the Pacific Gas and Electric Company feels that the proper safeguards have been taken to insure an uninterrupted supply



Trenching machine in action near Tres Pinos.

of natural gas to the Bay area and will then be ready to supply natural gas to all consumers. The completion of the entire project as outlined, the Valley line and the present Buttonwillow-Milpitas system, will require the expenditure of approximately \$26,000,000. Nearly eight hundred miles of natural gas transmission lines, in all, will be installed, with the necessary compressor plants and metering stations, making this one of the largest natural gas transmission systems in the United States and supplying service to over 500,000 domestic consumers.

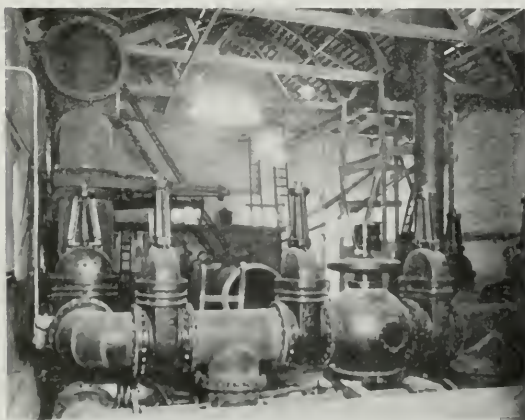
The benefits of natural gas as a fuel for domestic and industrial purposes have long been recognized, but it has only been within the last year that a gas supply has been developed near enough to the Bay area to make possible the introduction of this ideal fuel into the Pacific Gas and Electric territory. The construction of this great natural gas transmission system permits the supplying of the entire market with this fuel in the areas near the pipe line system and provides an outlet for the gas from the oil fields. The



220-foot suspension bridge over Panoche Creek, San Benito County.

conservation program of the Government and also the new California Gas Conservation Law make it necessary to find a market for the gas which may be produced from oil wells, otherwise, the oil production will have to be closed in as the new law is designed to eliminate the wastage of gas. The market for natural gas in Southern California was unable to use all of the gas being produced in oil field operations, with the result that great volumes of gas were being wasted. The new gas and oil developments in the Kettleman Hills had no outlet for their gas unless a new market was found and the Pacific Gas and Electric Company has provided this market by the construction of this great natural gas transmission system to the Bay area. Thus the introduction of natural gas to San Francisco and Oakland is not only of benefit to the gas consumers in this territory, but it also assists the oil industry in carrying on developments in the San Joaquin Valley.

Wherever natural gas has been introduced, a marked increase in industrial development has been noted due to the superiority of this fuel for manufacturing processes, where heat is required. Many industrial plants now using other fuels will find an advantage in using natural gas and new industries will be attracted to the Bay area. The completion of this great system will herald a new industrial era in Northern and Central California.



Automatic device for mixing natural and artificial gas, Potrero works, San Francisco.

Our Newly Acquired Properties— California Telephone & Light Co.

An executive order issued July 22nd announced the merger in the "Pacific Service" system of the properties of the California Telephone and Light Company, an organization supplying service in the counties of Mendocino, Lake, Sonoma and Napa. This company's system and the territory covered by its operations now become a part of Pacific Gas and Electric Company's North Bay Division.

As a matter of fact, these properties have been operated by Pacific Gas and Electric Company for the past six years, following the purchase of a controlling interest in the California Telephone and Light Company on May 3, 1923. They have been operated, however, as a separate unit. Now that the properties have been formally deeded over, their complete merger adds an interesting as well as rapidly growing section of Northern California to the "Pacific Service" territory.

Meanwhile, the C. T. & L. electric system has been largely reconstructed under "Pacific Service" operation and control. The substations have all been rebuilt and increased in capacity. A new substation has been built and many miles of new distribu-

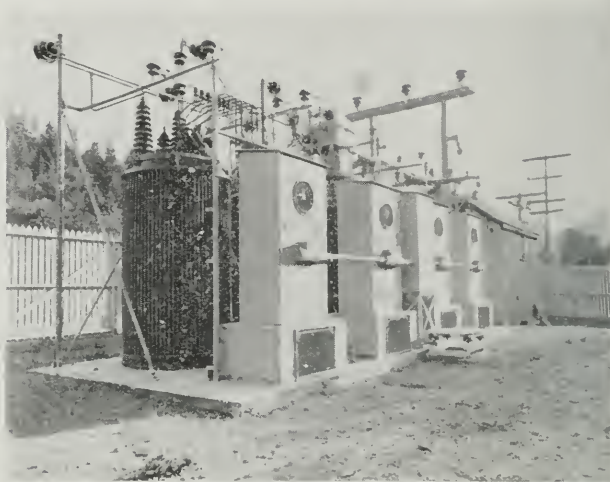
tion lines have been added. The system has been enlarged in scope by the purchase of two independent organizations, the Lake County Water and Power Company, purchased in 1928, and the McKinley Brothers' electric system, operating in Middletown, Lake County, purchased in 1928. An active sales program has increased the load on the system, while unified control has reduced cost of management and operation, improved service and reduced rates. The sale, in February, 1927, of the California Telephone and Light Company's telephone business to the Sacramento Valley Telephone Company enabled Pacific Gas and Electric Company to bring the C. T. & L. system within the well-defined scope of "Pacific Service" activities and so paved the way for the complete merger above referred to.

The California Telephone and Light Company was organized in November, 1911. It was a consolidation of a number of independent power and telephone companies serving various isolated sections in Sonoma, Mendocino and Lake Counties. These concerns included the Healdsburg Telephone Company, Russian River Light and Power Company, Northwestern Electric Company,



A modern dehydrator plant near Forestville, Sonoma County. While oil supplies the heat required for dehydration, every mechanical process, including peeling, sorting and sulphuring, is done by electric power.

Clear Lake Consolidated Telephone and Telegraph Company, Sonoma Valley Light and Power Company and Cloverdale Light and Power Company. The consolidation extended its activities into Napa County with the purchase of the Calistoga Electric Company in January, 1918. The Mt. Konocti Light and Power Company, operating in the vicinity of Clear Lake, was purchased in December, 1919. Additional electric distribution facilities were obtained by the purchase of a distributing system adjacent to Ukiah which had been constructed as a co-operative farmer enterprise to supply power for an irrigation project, and additions to this line were constructed as occasion required. The Snow Mountain Water and Power Company's distributing system in Potter Valley was purchased. The company maintained no electric generating system of its own, but purchased electric energy wholesale from the Snow Mountain Company operating a hydro-electric plant in Potter



Green Valley substation, on the Russian River near Forestville.

Valley, near Ukiah, with substations at Ukiah, Hopland, Asti and Healdsburg, and from the Pacific Gas and Electric Company at its Santa Rosa, Sebastopol and Sonoma substations.

The demand for electric service grew, in time, beyond the company's facilities and in 1923 its system was taken over by the Pacific Gas and Electric Company under the contract of purchase referred to.



Sebastopol is famous for the Gravenstein apple. This single tree has produced 138 boxes in one season.

At the time of this change the territory served by the California Telephone and Light Company in Sonoma County included the town of Sonoma and environs; the suburban territory adjacent to Santa Rosa and Sebastopol, including the town of Cotati, on the one side, and running over from Occidental into the Russian River country as far as Duncan Mills; the city of Cloverdale and adjacent territory;

in Mendocino County, the territory around Hopland, Ukiah and Potter Valley; in Lake County, Lakeport, Middletown and the territory around Clear Lake; in Napa County, the town of Calistoga and adjacent territory north of Bale substation. The company maintained telephone exchanges in Sonoma, Guerneville, Healdsburg, Potter Valley, Lakeport, Middletown and Calistoga, and also operated all of the suburban telephone lines adjacent to Santa Rosa and Sebastopol. As already stated, however, in 1927 these telephone properties were disposed of.

It is a section of country that possesses many attractions. Sonoma is an unusually rich agricultural county. Its importance in this respect can be gathered from the following figures taken from the report of the County Horticultural Commissioner for the year 1928:

"Poultry products, \$17,500,000; grapes, \$1,434,150; prunes, \$2,700,000; apples and cherries, \$1,000,000; dairy products, \$2,500,000."



Apple packing plant at Sebastopol.

Electric power is extensively used in the poultry industry for incubating, brooding and, during the winter months, for lighting of poultry houses to create a longer day and increase egg production. The grading, processing and testing of eggs for the market is an important factor and creates a considerable demand for electric power in the various cities located in the poultry centers. Petaluma (not in the C. T. & L. territory) is known as the egg basket of the world, but other sections in Sonoma County, particularly Cotati, Windsor and Sebastopol, are rapidly increasing in their importance as poultry producers. The Sebastopol section supplies the principal output of early Gravenstein apples, 2,000 carloads being the

average pack in a normal year. The Healdsburg section leads in the production of prunes, with nearly 20,000 acres of bearing orchards and approximately 5,000 acres non-bearing young trees, with an average tonnage of 25,000 tons, while Cloverdale and Geyserville lead in the grape production, nearly 20,000



Gravel plant of the Russian River Gravel Company at Healdsburg.

acres being in bearing grapes and an annual tonnage of approximately 45,000 tons.

Sonoma County, besides being blessed with rich natural resources in fertility of soil, picturesque scenery and a wonderful climate, also has a very colorful and picturesque history. It was in the town of Sonoma that the Mission of San Francisco Salano was established in 1823 by Padre Jose Altamira. It was on the Sonoma coast that the Russian colony at Fort Ross was established in 1812, Russia claiming possession of California by this occupation for a period of thirty years when the property was purchased by General John Sutter of Sacramento. It was in Sonoma that General Mariano G. Vallejo established his pueblo in 1834 and was commissioned by the Mexican government as military governor of Alta California. He held sway throughout Sonoma County until he was overthrown by the Bear Flag Party, who raised the Bear Flag in the square in front of the mission and established California as an independent republic. The flags of five countries have successively waved over Sonoma County. The home of General Vallejo, located at Sonoma, is presided over by Gen-



Asti substation, in the vineyard of the Italian-Swiss Colony, near Cloverdale.

eral Vallejo's daughter, Mrs. Lulu Cernan, and is open to visitors, who may spend a very pleasant hour inspecting the curios in the museum and beautiful gardens. The Mission building at Sonoma was purchased by the Landmark League of California in 1902 and presented to the State of California, that it might be preserved as an important historic landmark. Through the efforts of various patriotic organizations and by State aid, the Mission has been fully restored and is now used as a free museum for housing various historic relics of early California history.

Those in search of recreation and vacation have not been slow in taking advantage of



Alexander Valley, from the Redwood Highway, near Geyserville, Lake County.



The Sulphur Bank quicksilver mine, on the border of Clear Lake, Lake County.

Sonoma's excellent climate, curative mineral waters and hot springs, and the Redwood scenic beauties along the coast. On the Russian River pleasure resorts and summer homes extend from Healdsburg to Jenner-by-the-Sea and it is estimated that the summer population approximates 100,000 people during the months of July and August. During the early days of Sonoma's history, the redwood forests contributed largely to the lumber industry, but now that the original trees have been removed and second growth established in the cut-over areas,

summer homes are being erected on the lands which once provided material for the lumber industry. Electricity plays a very important part in providing these homes with the modern conveniences.

Mining is another industry which has been more or less important, the commonest being the removal of sand and gravel from the Russian River for construction purposes. Next in importance is quicksilver, which has recently received a new impetus from the high price of that metal. In northern Napa County, near Calistoga, is located the Pali-

sades silver mine, which has been worked for over twenty-five years. Electricity provides the motive power for all of these industries. In Lake County, the Sulphur Bank mine has an installed capacity of over 1,000 horsepower.

Lake County was hindered in its development by lack of rail or even adequate auto road facilities until 1921,



Clear Lake substation, built by "Pacific Service" in 1928.

when the first State highway was constructed, replacing an old toll road. To this original highway have been added two other State highway outlets, also replacing toll roads, and a fourth highway outlet is now under construction from Clear Lake to the Sacramento valley. This highway development has played an important part in stimulating agricultural activities, particularly the growing of pears and walnuts. Lake County pears are now being shipped to the world's markets and commanding the highest prices on account of their excellent quality. Shipment of pears from Lake County in 1928 was 20,000 tons and of walnuts, 260 tons.

The scenic attractions of Lake County are too well known to need description here. Clear Lake is a broad sheet of water, twenty-eight miles long and nine broad. It is extremely picturesque. Pleasant country homes are dotted around its borders. Quite a pretentious resort is springing up at Lucerne on



Reclamation project near Upper Lake, at the head of Clear Lake. The building in foreground houses a 70 h. p. electric pumping plant.

the east side of the lake, with a huge hotel nearing completion. It is only of recent years, however, that the agricultural industry has been prosecuted to any extent on its borders. But the advent of available electric power has worked wonders. Pear orchards now bloom where once there was untilled soil. Some idea of the progress may be gathered from the fact that where there were 10 riparian owners fifteen years ago there are now something like 25,000. Reclamation projects are in process. Two of these are located near the town of Upper Lake, where approximately 2,000 acres of former lake

lands are being prepared for agricultural development by means of electric pumping plants.

Our company has done its part during the period that this territory has come under its operation. The Clear Lake substation located near Kelseyville was completed and placed in operation during 1928. This station is of 15,000 k.v.a. capacity, with automatic voltage



Tule Lake, near Upper Lake. This lake is emptied of its water every year after the rains and planted to string beans. These are canned in Upper Lake.

regulation and automatic re-closing switches. In order to supply this station an 11½-mile 60,000-volt line was built from Hopland. The original 11,000-volt line from Hopland that supplied Lakeport and Kelseyville has been retained as a second source of power for this territory. In June, this year, there was delivered through this substation for consumption in Lake County more electric energy than was sent out over the entire California Telephone Light and Power Company's system five years previous.

Concerning the other substations on the system. The Asti substation, located near Cloverdale, has been completely rebuilt, with new switching equipment and automatic re-closers. The Green Valley substation, supplying the Russian River resorts, has been rebuilt, its capacity increased to 1500 k.v.a., and automatic regulators and switches installed. The substation at Healdsburg has been rebuilt, its capacity increased to 900 k.v.a., with automatic regulators and switches. The substation at Hopland has been increased to 750 k.v.a. capacity, with automatic regulators and switches. The substation at Sonoma has been rebuilt. The



Packing plant of the Lake County Fruit Exchange, near Kelseyville. There are eight similar plants in the county.

Ukiah substation has been completely rebuilt and increased to 400 k.v.a. capacity.

In addition to the above, power is received at Bale station, near St. Helena, for distribution to Calistoga, the Palisades mine and Middletown. Power is also received at Cotati, Potter Valley, Santa Rosa and Sebastopol for local distribution.

In the way of electric distribution, there is the line from Kelseyville to Lower Lake, the Sulphur Bank mine and Clear Lake. The distribution system at Middletown already referred to at the time of purchase gave service from a small water-power plant during a portion of the day, the power being utilized by a flour mill for the balance of

the time. There is now a complete 24-hour service, through a line extension from the Calistoga system to Middletown. Extensions of the distribution system from Sebastopol have been made to Bodega, Bloomfield, Tomales and the Marshall station of the Radio Corporation in Marin County. The lines acquired at the time of purchase around Clear Lake and around

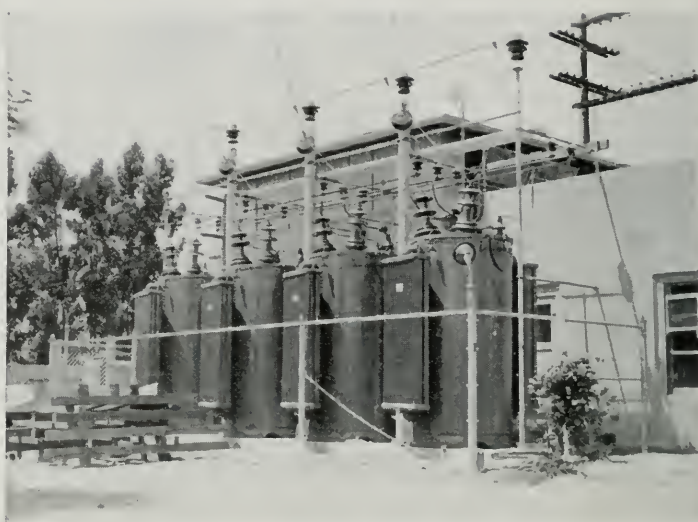


Orchard of pears and walnuts under irrigation in Lake County. Electric pumping.

the Russian River have been completely rebuilt as well as elsewhere on the system. Numerous other extensions have been made.

The load served by the California Telephone and Light Company at the time of its acquisition by the Pacific Gas and Electric Company was, to a very large extent, scattered over a relatively sparsely settled area including no large centers of population. As a result of this the capital investment and operation costs were relatively high and these were reflected in comparatively high rates. The high rates, in turn, discouraged the extensive use of electricity in the home and on the farm.

The Pacific Gas and Electric Company realized that to popularize the use of electricity it was vital that the rates be reduced, thus bringing about an increase in consumption by encouraging the installation of more appliances by existing consumers as well as by the addition of new consumers through



Substation and office building at Sonoma.

the electrification of homes and farms not served before. To accomplish this end an active sales program was instituted and every legitimate means was used to build up the load on the California Telephone and Light Company's system. Unified control made possible by the purchase of the properties materially reduced the costs of management and operation, at the same time improving the service generally. Besides, on account of the large metropolitan and extensive agricultural load served by the Pacific Gas and Electric Company with relation to



The Mission of San Francisco de Solano, at Sonoma Established in 1823. Restored in recent years.

the load of the California Telephone and Light Company it was possible to reduce the rates, except in one or two instances, to a parity with those of the Pacific Gas and Electric Company without affecting the interests of the latter's consumers.

The saving to consumers of the California Telephone and Light Company as a result of this policy is very strikingly shown by a comparison of the charges for service in 1923 with those of today. A domestic consumer in incorporated territory using lights and small domestic appliances would, on the basis of an energy consumption of 50 kilowatt-hours per month, have paid \$6 per month under the old C. T. & L. Co. rate. Today he would pay \$2.70 for the same service. This represents a reduction of 55 per cent. A like consumer in unincorporated territory would have paid for the same service, in 1923, \$6, whereas he pays today \$3.20, a reduction of 47 per cent. A consumer in rural territory using lights in combination with heating or cooking service,

would have paid, on the basis of a consumption of 200 kilowatt-hours a month, \$9.05. The same consumer today pays \$7.85, a reduction of 13 per cent.

A farmer operating a 10-horsepower motor, the energy consumption of which was 9,329 kilowatt-hours per year (ranging from 300 kilowatt-hours to 2,000 kilowatt-hours per month throughout the year), would have paid \$296.58 for the twelve months of the year. Today the same farmer pays \$185.61, a saving of 37 per cent.

In conclusion, the following figures reveal the growth of the C. T. & L. electric system under "Pacific Service" operation to date:

Miles of overhead distribution lines. In 1923, 484.10; in 1929, 801.38.

Consumers. In 1923, 6,506; in 1929, 10,606.

Total connected load. In 1923, 11,499.67 horsepower; in 1929, 33,531.92.

Kilowatt-hours sold. In 1923, 4,265,487; in 1929, 13,989,880.



Map of territory covered by former California Telephone and Light Company's system.

"Pacific Service" and Agriculture— Fruit Farming in Salinas Valley

By JAS. F. POLLARD, *Manager Coast Valleys Division*

The attention of readers of PACIFIC SERVICE MAGAZINE has been called in previous articles during the past year to the agricultural possibilities of the Salinas valley, with particular reference to the broad acres of tillable land lying south of the town of Salinas.

This region is of special interest to our company just now, for by its recent acquisition of the properties of the former Coast Valleys Gas and Electric Company the counties of Monterey and San Benito have been added to the "Pacific Service" territory. Transmission facilities are in process of reconstruction and reinforcement, and our company expects in the near future to materially assist in the agricultural and industrial expansion of a section of country which through its advantages of soil and climate promises ample return upon investment.

One hundred and sixty years have elapsed since the Spanish padres and soldiers trudged their weary way through this land in the cause of God and King. Many changes have been recorded since then. Time was when the cattle barons, maintaining their vast holdings under Spanish grants, held sway and their cattle roamed at will over hill and dale. Then came the wheat grower in the valleys, and after him industries of various

kinds came to be established. Dairying, alfalfa culture, beans, potatoes, lettuce and other green vegetables. The irrigation problem was a hard one, at first, but in the course of years this came to be solved satisfactorily. Last year the lines of "Pacific Service" in the Coast Valleys division supplied energy to pump irrigation water for more than 15,000 acres of lettuce, serving some 3,000 horsepower of pumping motors.

In this comprehensive scheme of agricultural development fruit growing now plays a not unimportant part. The combination of fruit and vegetable culture upon the same tract is not unusual. But it took men of both foresight and determination to do the pioneering. A striking example is furnished by the story of the Salinas Land Company and its subsidiary, the California Orchard Company.

The Salinas Land Company owed its inception to the enthusiasm of one Joe Moore, a resident of that section, who in 1917 conceived the idea that there was money to be made and, at the same time, a public service to be performed if he could interest the right people and could assist them in locating a comparatively large tract of raw land. This, after being brought to a high state of development, could be subdivided and thus afford comfortable as well as prosperous locations for willing tillers of the soil. He succeeded in interesting Messrs. C. C. Teague, President of the Citrus Growers Association and identified with many other successful agricultural enterprises in the State, John Lagomarsino, one of the founders of the Bank of Italy and a well-known bean grower and wine merchant, and A. L. Hobson, of Ventura, a successful stockman and meat packer. These men agreed



California Co.'s orchard in foreground. Salinas Land Co.'s bean fields in background. Salinas River beyond.

to put their financial resources and business acumen behind the enterprise.

Investigation of available acreage resulted in the selection by this group of the old Dunphy ranch, near King City in southern Monterey County, in the upper reaches of the valley of the Salinas River. The Dunphy ranch was a part of the Los Ositos rancho that had been granted to the Espinosa family by the Spanish governor of California in early days. It contained some 8,000 acres of tillable soil and 1200 acres of range lands. The tillable soil had been planted to barley and



Apricot orchard interplanted with Lima beans.

had a value of something like \$50 an acre. Mr. Hobson, as a stockman, became interested in the range lands, while Mr. Lagomarsino, as a bean grower, was intrigued by the availability of the gently sloping valley for bean culture.

In this way the enterprise was launched. Three years later, in 1920, the specialized experience of Mr. Teague as a fruit man was brought into play through the formation of a subsidiary company by the same group which was called the California Orchard Company. To this was allotted some 2,000 acres of the tillable land belonging to the parent concern.

At first the older residents of that section were heard in predictions of failure for the entire enterprise. The water problem appeared to be insoluble. To be sure, there were successful wells in the river bed and in the lowlands east of the river, but the situation, it was thought, was different on the west side. But the leaders of the twin enterprise had faith and went steadily on with their work of development. An irrigation system was constructed. Approximately 100 miles of concrete pipe was laid to convey water to the 8,000 acres of tillable soil. Numerous wells were drilled along the lower side of the ranch, on the mesa just above the river, and from these the



Luxuriant growth of Lima beans from interplanting in orchard.

water was forced to the upper levels through this pressure pipe system.

The Salinas Land Company at the present time operates ten wells and pumping plants varying in size from 40 to 350 horsepower and having a total connected load in electric motors of 1245 horsepower. The California Orchard Company operates four wells, each 250 feet deep and in which the water stands at approximately 75 feet below the surface. These wells are equipped with 150-horsepower motors and 16-inch Layne and Bowler deep well pumps, each of 2,000 gallons per minute capacity. From this battery of wells a 20-inch steel pipe line 7,200 feet long runs approximately at right angles to the river to a booster pumping station located at an elevation of 90 feet above the well plants. From this the water is carried through 4,500 feet of 16-inch steel



Fruit trees in what was once a barley field.

pipe to a further elevation of 150 feet to irrigate the upper lands. From these steel pipe lines at intervals of 600 feet lateral concrete pipes varying from 10 to 18 inches in diameter distribute water to all of the orchard lands.

This booster station deserves special mention as an excellent example of efficient agricultural engineering. It contains three pumps, two of which are driven by 75-horsepower motors and the third by one of 150 horsepower. All of these are so interconnected and controlled by valves that they are operated at full rated load, hence maximum efficiency can be obtained at all times while pumping to the various levels on the upper portions of the ranch. When watering the zone where the lift is 50 feet or less, the two small pumps operate in parallel. In the zone where the lift is from 50 to 100 feet they operate in tandem, and when water is needed on the highest zone up to 150 feet the two smaller pumps can be operated in tandem with the larger pump.

Both companies have taken full advantage of the cheap power rates available to agricultural pumpers who maintain a high load factor. All of the plants are kept down to a minimum size commensurate with acreage to be covered and lift to be accomplished and during the irrigation season are run practically continuously. The results of this arrangement are shown by the fact that in spite of the comparatively high lift, which averages 150 feet, it is possible to water a double crop—peas followed by beans—for an average cost of \$10 per acre. During the



Superintendent W. E. Goodspeed examines a heavy-bearing prune tree.

1927-1928 season "Pacific Service" sold these two companies a total of 4,534,840 kilowatt-hours and in the following season 4,665,220 kilowatt-hours.

The Land Company has devoted its efforts almost entirely to the cultivation of beans. The operation has been carried on through lease arrangements with tenants each of whom is assigned approximately 300 acres of land. The company receives a share of the crop and, in addition, a cash payment to cover interest and depreciation on the irrigation system. Power bills are paid for the entire ranch by the land and orchard companies, which collect pro rata from the various tenants to cover this expense. The furrow system of irrigation is followed on both the bean and



Heavy-bearing apricot trees on California Orchard Company's ranch.

orchard lands, which latter were also interplanted to peas and beans during the development period while the trees were young. The Salinas Land Company has proven that this section is the best known location in the State for the culture of pink beans, producing a better quality and being ready for market earlier than any other. It is also well adapted to Limas and baby Limas.

It is interesting to note that in 1920 the average yield per acre was 12 sacks of pink beans, whereas the average for the whole 6,000 acres is now 24 sacks to the acre. There are several reasons for this. In the first place, beans being a leguminous plant increase the fertility of the land by putting back nitrogen into it; then, the tenants have learned by experience and under the guidance of the Land Company's superintendent how to irrigate under conditions that exist in this region. Most of these growers were recruited in the Ventura district where they were used to a richer and heavier soil and were in the habit of giving the land but two heavy irrigations per season. Experience has shown that lighter and more frequent irrigations are better for the light soils and the windy conditions in this section, and now six light irrigations per season are used about 14 days apart, starting about three weeks after planting. When the pumps are started they run continuously night and day, rotating from one lease to the next, and then, when the whole ranch has been covered, they are just ready to start over again. Each tenant grosses from \$5,000 to \$10,000 per year and all are well satisfied. Many are buying lands of their own in the neighborhood out of the profits realized from this enterprise.



Method of furrow irrigation in 8-year-old walnut orchard.

Carlyle Thorpe, general manager of the California Walnut Growers Association, was early selected as manager of the California Orchard Company. His genius has been a material factor in the success of this development, operation of which is so closely allied with his experience in the Walnut Association. He has been ably assisted from the beginning by W. E. Goodspeed, who is resident superintendent of the Orchard Company. James Kelley is resident superintendent of the Salinas Land Company.

Orchard planting was carried on over a three-year period from 1920 to 1922 inclusive. To overcome the effect of the heavy winds to which the upper Salinas valley is subject, wind-breaks of eucalyptus trees were planted across the land at intervals of 800 feet. In selecting the kind of trees to plant a wide diversity was sought, first because there was little or no precedent to follow; second, because of a desire to take advantage of every kind of market that might be available. There are now in full bearing or just ready to come into bearing 400 acres of apricots, 300 of almonds, 350 of pears, 350 of apples, 175 of walnuts, 100 of prunes, 75 of grapes and 75 acres of peaches. While all of these are in fine condition and doing well, the apricots would appear to be first choice, with almonds a close second.

The crops are so arranged that advantage can be taken of the best market. For instance, in handling the apricot crop this year 800 tons will be dried, 500 tons shipped green and 200 tons will go to the cannery.



Group of 4 wells, total 600 h. p., and P. G. & E. 440-volt transformers, California Orchard Company's ranch.

The Orchard Company has a site at King City and plans to put in a cannery to handle its own crops, if necessary. It will not do this, however, as long as it can find suitable market. At the present time part of the crops are handled at San Jose by the California Packing Corporation and by local canneries at Santa Cruz and Salinas.

The Orchard Company maintains a regular crew of from 50 to 75 men. At the height of the harvest season it employs 400 workers.

The Coast Valleys division is proud of this development which has grown up in its midst and in whose success electric power has played so important a part. One of its substations is named "Orchard" and is devoted entirely to the service of this load. In addition, King City substation and Greenfield No. 1 are called upon for power.

To insure adequate power facilities for this new addition to the "Pacific Service" territory our company has recently constructed a new double-circuit 110,000-volt steel-tower line from Newark substation to a new distributing substation at Morgan Hill. This line is now in process of extension to the former Coast Valleys Company's substation at Salinas. From Salinas south to King City the territory is covered by two 60,000-volt lines and one of these has recently been extended to San Ardo, at the southern extremity of the system. Electrical consumers in that region will undoubtedly benefit thereby.



Interior booster pumping plant, 300 horsepower.

Progress of Salt Springs Project— Big Dam One-Quarter Constructed

Work upon our Salt Springs water and power development, in the upper reaches of the north fork of the Mokelumne River near the border line of Alpine County, has progressed so satisfactorily that the construction crews working on the big dam have something to show for their labor.

It is an undertaking of no small magnitude to span the wide gorge at that spot with a structure which, when completed, will be 330 feet high, 1300 feet in crest length and will measure 800 feet from upstream to downstream toe. Our engineers estimate that the dam will contain 3,000,000 cubic yards of rock-fill. So the information that it is now one-quarter constructed presents to even the lay mind a picture of definite accomplishment.

Work on this development started in the early summer of 1926. At that time, however, the dam site was almost inaccessible, for it lies several thousand feet below the Alpine highway running from Jackson into

Nevada and there was no available means of transportation to the spot save a small road leaving the highway at a forest ranger's station some thirty-seven miles out from Jackson, where the elevation is 6,500 feet above sea level, and plunging down the precipitous slope a distance of five miles to a ranch. This our company's engineers made use of at first, reconstructing it and carrying it down to the Bear River crossing, a drop of 3,000 feet in all from the highway. From that point the road was carried along the north bank of the river to the dam site, a distance of about thirteen miles. This, however, did not provide all-the-year-round transportation. A second and more substantial means of approach was carried out in the construction of a broad, rock-surfaced road taking off the highway at Barton's, twenty miles out from Jackson and where the elevation is only 3,300 feet. This road, which is of permanent construction, winds its way to the Bear River crossing by way



View showing progress of dam construction at Salt Springs. At left, the fill from the main quarry; at right, the fill from the spillway.

of Tiger Creek, passing within four miles of the site marked for the Tiger Creek power house that will be the major power development of the new project.

All this took time. It was not available for use until the winter of 1927. Then came the work of erecting a permanent construction camp at Dead Man's Flat, near the power house. This was completed in the early spring of 1928. It may be said, then, that the real construction work started from that point.

A temporary diversion dam was constructed at the upstream end of the project and the water of the Mokelumne River diverted into a 1200-foot tunnel, nineteen feet in diameter, bored through solid rock on the north side of the stream. Next in order was



One of the two 4-yard electric shovels in the main quarry. This shovel can lift rocks of 35 tons weight.

the construction of a concrete cut-off wall at the upstream face of the dam. This, with about fifteen feet of permanent structure above it, protected the river bottom from the winter storms. In the meantime, bed-rock at the dam site was cleared and exposed and in every way placed in order for

the coming work. It was not until all that had been accomplished that a quarry on the north side of the stream was opened up and the work of rock pouring into the dam started.

At the close of 1928 it was estimated that 135,000 cubic yards of material had been placed. At the time of writing our engineers report that the dam is one-quarter constructed and that at the present rate of progress



2-yard electric shovel loading a special Athey trailer in the spillway. This is the first time that special equipment of this size has been used.

completion is assured in time to impound water in the summer of 1931. With modern appliances, such excellent speed has been obtained that in the month of June this year 140,000 cubic yards of rock-fill was placed in the now developing structure.

Other progress has been made. Work of boring a two-mile tunnel along the line of water conduit between the site of Salt Springs dam and that of Tiger Creek power house has proceeded to a distance of about 100 feet at either end. This tunnel, eleven feet in diameter, starts about twelve miles downstream from the dam site and travels through a high ridge on the easterly side of Panther Creek.

About one-half mile of excavation work has been done for a roadway upon which will be laid a reinforced concrete box-flume that will be part of the water conduit. This flume will be 7 feet deep and 13 feet wide. It is a rather unusual form of construction. The water conduit between dam and power house will be about twenty miles in length and the water will be carried partly by flume, partly through tunnel and partly through pressure pipe.

At our company's sawmill situated some two miles below the dam site there has been cut some 3,000,000 feet of timber for general construction uses. And now it is proposed to reconstruct the old Tiger Creek sawmill that was a feature of the first Electra power development. This will be used as an auxiliary mill and timber will be cut there for the lower part of the Salt Springs-Tiger Creek project.

The work of clearing the reservoir site above the dam preparatory to partial storage in 1930 has gone ahead with a small crew. The timber in this area has been con-

verted into lumber and firewood for general construction use in the vicinity.

The major interest, of course, is centered upon the big dam. The work of blasting off great sections of solid rock to provide loose material and of loading this rock with power shovels into large steel cars and tractor-drawn vehicles has gone ahead on day and night shifts without interruption. When first work started in the rock quarry the usual rock-drill was used to bore holes capable of containing from 100 to 200 pounds of dynamite. As the quarrying proceeded and greater space was afforded, well-drills were brought into play. These are able to bore holes of 6 inches in diameter and from 60 to 200 feet or more in depth. A hole of this size, when enlarged at the base by the use of explosives, will hold from 1500 to 2500 pounds of dynamite. When a row of 15 or more has been drilled these are loaded and shot simultaneously, with the result that thousands of cubic yards of rock are broken up at one time. At the time of writing the crews are boring a single row containing as many as 45 of these holes. Their aggregate charge amounts to about 50 tons of dynamite, enough to break down about 250,000 yards of rock.

The company's expenditures for permanent transportation to the dam site, for a 50-mile power line from Electra for construction purposes and for several hundred thousand dollars' worth of special equipment for dam construction have been well justified. With these facilities, the construction crews are now doing easily and at much less cost nearly as much work in a single month as they were formerly able to perform in the Sierra region during an entire summer season.



The Financial Side of "Pacific Service"

EARNINGS

Following is a preliminary statement of the Company's income account for the twelve months ended June 30, 1929, compared with the corresponding period of the preceding year:

	12 MONTHS TO JUNE 30, 1929	INCREASE
Gross Revenue (including Miscellaneous Income).....	\$64,031,820	\$3,362,971
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rentals and Reserves for Casualties and Uncollectible Accounts....	32,052,141	1,133,503
Total Net Income	\$31,979,679	\$2,229,468
Bond Interest and Discount.....	10,512,410	779,220*
Balance	\$21,467,269	\$3,008,688
Reserve for Depreciation.....	6,458,755	609,811
Surplus	\$15,008,514	\$2,398,877
Dividends Accrued on Preferred Stock.....	4,761,175	29,685
Balance	\$10,247,339	\$2,369,192
Dividends Accrued on Common Stock.....	5,825,165	505,458
Balance	\$ 4,422,174	\$1,863,734

*Decrease

Gross revenue from all sources increased \$3,362,971, or 5.5%. This compares with increases of 9.0% in kilowatt-hour sales of electricity and 9.8% in cubic feet of gas sold, the smaller relative increase in gross revenue, as compared with the physical volume of gas and electric sales, being attributable to the lower average rates in effect during the last twelve months' period.

The substantial decrease of \$779,220 in fixed charges is due primarily to refunding operations conducted in the latter part of 1927 and the early months of 1928; and also, in a lesser degree, to the fact that the amount of interest chargeable to construction account, on account of the larger volume of construction work now in progress, is somewhat higher than a year ago.

The balance available for dividends upon the Company's common stock was equivalent to \$3.23 per share upon all common stock outstanding at June 30, 1929. On that date, there were outstanding or subscribed for 3,167,829 shares of common stock which were held by 20,611 investors, the number of holders of our common shares having increased by 2,049 in the past six months. There was also an increase of 4,632 in the number of preferred stockholders during this period, there now being 35,138 holders of preferred stock and 55,749 stockholders of all classes.

Our business continues to exhibit a satisfactory expansion in sales volume, particularly in the field of commercial and domestic usage of electricity, kilowatt-hour sales of energy for these purposes showing in the first six months of the current year an increase of 19.2% compared with the same period of 1928.

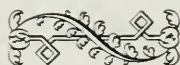
CONDENSED CONSOLIDATED BALANCE SHEET, JUNE 30, 1929

ASSETS

Plants and Properties.....		\$389,726,492
Investments		230,424
Discount and Expense on Capital Stocks.....		9,306,224
Trustees of Sinking Funds		634,893
Current Assets (including \$9,677,931 cash).....		22,675,349
Deferred Charges:		
Discount and Expenses in Process of Amortization.....	\$9,309,627	
Undistributed Suspense Items.....	114,108	9,195,519
Total Assets.....		\$431,768,901

LIABILITIES

Common Stock Outstanding and Subscribed.....	\$ 79,195,715
Preferred Stock Outstanding and Subscribed.....	83,874,007
Stock of Subsidiary Companies Owned by Public.....	26,756
Funded Debt in Hands of Public.....	206,926,200
Current Liabilities	\$6,741,973
Accrued Liabilities	8,262,699
Total Current and Accrued Liabilities	15,004,672
Reserves for Renewals and Replacements.....	24,549,104
Other Reserves	3,811,344
Surplus Unappropriated	18,381,103
Total Liabilities	\$431,768,901



Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF THE
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII JULY, 1929 No. 9

After thirty-one years of active and useful service, our well-beloved First Vice-President and General Manager, Frank A. Leach, Jr., retires to private life.

His resignation was handed to the President and Board of Directors at the opening of the present fiscal year, July 1, accompanied by the statement that he desired to be relieved from the strain of public service and to devote the balance of his life to the care of his private interests.

He decided upon this course only after earnest consideration and, his decision being unalterable, the Board of Directors accepted his resignation to take effect July 31. Their action was accompanied by the adoption of the following resolutions:

"WHEREAS: After thirty-one years of service with this Company, Frank A. Leach, Jr., First Vice-President and General Manager, has expressed a desire to lay down the cares and duties of business and to retire to private life in order to enjoy the freedom and comforts of leisure and has presented to this Board his resignation as First Vice-President and General Manager, to take effect July 31st, 1929; and

"WHEREAS: The services of the said Frank A. Leach, Jr., beginning with his employment as a junior clerk and continuing through the offices of assistant manager and manager East Bay Division, assistant general manager, vice-president in charge of public relations and service and, finally, First Vice-President and General Manager, have been marked for their constancy, loyalty and devotion to the Company, its stockholders and its customers, and stand forth as an example and model to be ever followed by the officers and employees of the Company; now therefore be it

"Resolved, That it is with a deep sense of loss to the Company, its employees, stockholders and customers, that this Board of Directors is called upon to accept the retirement and resignation of said Frank A. Leach, Jr., as Vice-President and General Manager, and that we do so with sincere regret and that we record his departure with reluctance and extend to him our best wishes and the best wishes of our stockholders and employees, for happiness and long life in the leisure and comfort he has so well earned."

Those resolutions, in the main, tell the story. The rest is found in a stream of messages of good-will and esteem that have poured into headquarters from the day his retirement was made known.

Mr. Leach began work for what is now the Pacific Gas and Electric Company in 1898 by taking a clerkship in the office of the Oakland Gas Light and Heat Company. He had previously been associated with his father, the late Frank A. Leach, Sr., in the publication of the *Oakland Enquirer*.

His first employment for the Oakland company was checking payrolls and making out bills. He was soon promoted to the counter to receive orders and complaints. Next, he became assistant to the late Mr. John A. Britton, who was then secretary and manager of the Oakland Gas Light and Heat Company.

In 1904, when the Oakland Company was consolidated with other companies to form the California Gas and Electric Corporation, Mr. Britton was brought to San Francisco to head the merger. Mr. Leach succeeded him as manager of the Oakland company. Later, when Pacific Gas and Electric Company was organized, he was made manager of its business in Oakland, Alameda and Berkeley and in surrounding towns in Alameda and Contra Costa counties, a position which he held for sixteen years.

In 1920, Mr. Leach, then recognized as one of the outstanding men in the gas and electric industry, was brought to San Francisco to be Assistant General Manager. A short time later he was promoted to the office of Vice-President in Charge of Public Relations and Service. Upon the death of Mr. John A. Britton, in 1923, Mr. Leach was elected to succeed him as First Vice-President and General Manager. In that capacity, he directed the operating forces of the Company during the six years that preceded his retirement.

A deep student, Frank Leach had a complete knowledge of the "Pacific Service" system in all its various branches. A sound judge of men and their capabilities, he won the respect as well as the regard of all who worked with him and for him.

We of "Pacific Service" are heartily sorry to see him go. We wish him all health, happiness and good fortune through the years that lie before him.

The thirteenth annual convention of the Pacific Coast Electrical Association, held at Del Monte, June 19-22, was distinguished above its predecessors by what may be termed the animated character of the program.

The spectacular was much in evidence. This year marked the fiftieth anniversary of the birth of electric light and the convention took *Light*, in both its historical and educational features, as its motif.

On the opening night upwards of six hundred men and women gathered on the lawn in front of the hotel and witnessed an electrical illumination of the grounds set in process by a huge aeroplane, which swooped down upon the scene to a height of about 500 feet from terra firma and by the sound vibrations from its propeller operated a sensitized switch located in the tower of the hotel. In an instant the hotel building and grounds were aglow.

Another striking feature of the convention program was a "Pageant of Light," presented in a series of tableaux, whereby the history of light was traced from the beginning of time. At the banquet on the closing evening the same idea was carried out. The tables were decorated with small lights and an impressive ceremony was the cutting of a huge frosted birthday cake. This came on illuminated with candles, and the transition came when dancers plucked the candles from the cake and electric light burst upon the scene.

The various sessions shared in the spectacular. The camera and talking movie were brought into play in illuminating addresses and both technical and commercial discussions. Humor played a not inconspicuous part, at intervals. Several skits were presented. Each of these, of course, had a background of educational import.

The keynote of the convention, then, was "More Light." It was sounded in spirited addresses by men of national repute. Dr.

Paul Fletcher Cadman, former Dean of the University of California, spoke at luncheon on the opening day. Messrs. J. F. Owens, of Oklahoma, vice-president of the N. E. L. A., and Paul Clapp, executive secretary, addressed the convention in general session. President M. S. Sloan was unable to make the journey from the East, but he gave the convention a stirring message through a movie-tone film.

As General Convention Chairman, R. Roy Cowles, of our Company's Auditing Department, had charge of all arrangements. His indefatigable energy and resourcefulness did much to make the affair the success it was.

In his opening address to the convention President P. M. Downing presented a comprehensive review of the progress of the electrical industry in the United States during recent years. From the facts as given we cull the following:

There are in the United States 23,400,000 purchasers of electricity, to which total 1,400,000 were contributed during the past year. Of these services 19,000,000 supply light, heat and incidental power to the homes of more than two-thirds of the country's 120,000,000 of population. New domestic consumers brought in during 1928 number 100,000. That there is work still before the industry is shown by the fact that there remain about 9,000,000 homes of the country not yet furnished with electric service.

The total electric energy produced in 1928 was 88,000,000,000 kilowatt-hours. This represents a gain of 50 per cent during the past five years.

The United States, with only 9 per cent of the population, uses as much electricity as the rest of the world combined. Three reasons are given for this: first, electric service is almost universally available; second, the standards of service are maintained to the general satisfaction of consumers; third, the price of service is well within its value.

In 1900 each American worker directed 2.11 horsepower. By 1925 this had increased to 4.27 horsepower. Our workers direct more horsepower than do those of any other country in the world. This increased use of power has increased production which, in turn, has given to American workers wages well in excess of those paid for similar work in any other part of the world.

Seventy-five per cent of the American factories are electrified, as against 66 per cent in Germany and 48 per cent in England. Central station electric service is used by 400,000 American farmers. Of this total 125,000 have been secured during the last three years.

Since 1912 the population of the United States has increased 25 per cent, but the amount of electricity produced has increased 615 per cent and the number of consumers 510 per cent.

One of the healthiest and most gratifying improvements in the industry during recent years is in the methods of producing and distributing electric energy. In 1928 the amount of energy generated by the use of fuel was 5.5 greater than in 1927, whereas the amount of fuel consumed was only 1.1 per cent greater. Thus it will be seen the increase in energy output was five times as great as the increase in fuel consumed.

The trend of the electric industry during recent years has been toward fewer and larger units. The economies that come from unified management and mass production are so well recognized that the era of large power units is inevitable.

Mr. Downing devoted a portion of his address to a discussion of the present-day business policy of the public utilities of the country, with its result in improved service, reduced rates and fair return upon investment. We quote:

"Along with other progressive industries, public utilities have demonstrated the soundness of the theory that the best business policy is one based on small, individual profits made possible through large volumes of business.

"Utilities have been criticized because many of them have consolidated and made a comparatively few corporations out of what were formerly numerous small companies. The bigger a thing is the more conspicuous it becomes. It is not surprising, therefore, that the large utility along with other large corporations should become the target of criticism by those who think that because a thing is large it is necessarily a menace. The truth of the matter is that these consolidations have linked up isolated plants, earning little and rendering only mediocre service, into great, inter-connected systems which have cut down overhead expenses, improved service, earned reasonable but not excessive dividends for millions of customer-owners, and at the same time reduced rates

"Contrast the situation here in the United States with that existing elsewhere. In London, there are sixty separate and distinct agencies supplying electric service at more than thirty different frequencies. Some of these are publicly owned and some are privately owned. The total amount of energy sold to the seven and one-half million people in that city is approximately the same as that sold by the Pacific Gas and Electric Company to less than one-third of the number of people, and the price in London is approximately double what it is in this State.

"Every wise utility executive is striving to make rate reductions, knowing that each justifiable reduction will not only meet with popular favor but will increase business and better establish his company as a truly public service organization. Such a policy has not only placed electric utilities in a dominant position among the industries that have contributed to the rapid advancement and prosperity of our country, but it has also resulted in saving to the general public during the last three years more than \$500,000,000 in the form of reduced rates.

"The spirit of service is rapidly permeating our entire industry. If there ever was a 'public-be-damned' attitude on the part of utility managements, it certainly does not exist today. Every progressive executive is thinking in terms of improving service, developing a more cordial attitude on the part of employees toward consumers and the public, and applying modern merchandising methods to increase business."

We deeply regret to record the passing of Charles Parmer Low, of the Stock Transfer Department, who died in San Francisco July 15th, aged 76 years.

Mr. Low was born at sea. His boyhood was spent in New York. Later he went to the Orient, where he engaged in the export trade. About 1900 he came to San Francisco and served for some time in the Tax Collector's office under his brother, J. O. Low. In 1914 he entered our company's employ.

He was a cousin of the late Seth Low, former Mayor of New York City. Early in life he married Miss Harriet F. Loring, daughter of the late David W. Loring, founder of the Loring Club of local musical fame. To the widow who mourns his loss we extend sincere sympathy and condolence.

"PACIFIC SERVICE"

IS FURNISHED TO OVER 1,009,500 CONSUMERS OF
GAS * ELECTRICITY * WATER * STEAM
 2,527,291 Total Population Served in Thirty-eight of California's Counties
 CITIES AND TOWNS SERVED BY COMPANY

		DIRECTLY		INDIRECTLY		TOTAL	
		No.	Population	No.	Population	No.	Population
Electricity	313	1,765,462	34	161,575	350	1,927,037	
Gas	83	1,795,965	5	14,702	91	1,810,667	
Water (Domestic)	21	25,400	4	18,500	25	43,900	
Railway	1	105,060			1	105,000	
Steam Heating	2	1,003,000			2	1,003,000	
Place	Population	Place	Population	Place	Population	Place	Population
Acampo.....	1,000	Cottonwood.....	704	Heckman.....	40	Nevada City.....	1,800
Agnew.....	125	Coyote.....	250	Hillsborough.....	1,000	Newark.....	1,100
Alameda.....	35,140	Crockett.....	2,500	Hollister.....	4,500	Newcastle.....	750
Albany.....	6,000	Crows Land-.....		Honcut.....	500	Newman.....	1,250
Alamo.....	100	ing.....	300	Hopland.....	500	Niles.....	1,850
Alleghany.....	300	Daly City.....	6,500	Hughson.....	625	Nord.....	60
Alta.....	100	Danville.....	500	Hydesville.....	200	Notoma.....	200
Alton.....	200	Davenport.....	500	Inverness.....	215	Novato.....	1,000
Alvarado.....	1,120	Davis.....	1,750	Jlone.....	900	North Sacra- mento.....	2,500
Alviso.....	640	Dayton.....	60	Irvington.....	1,200	Oakdale.....	2,000
Amador City.....	750	Decoto.....	700	Jackson.....	2,500	Oakland.....	295,000
Anderson.....	1,180	Del Monte.....	300	Jamestown.....	1,000	Oakley.....	300
Angel Island.....	500	Denair.....	400	Jenny Lind.....	100	Occidental.....	600
Antioch.....	2,800	Diamond.....		Junction City.....	50	Olema.....	155
Applegate.....	100	Spring.....	200	Kelseyville.....	600	Orland.....	2,100
Aptos.....	200	Dixon.....	1,200	Kennett.....	492	Ororo.....	7,000
Arbuckle.....	900	Dobbins.....	100	Kentfield.....	1,000	Paceco.....	300
Arcata.....	2,200	Downville.....	350	Kenwood.....	300	Pacific Grove.....	5,000
Artois.....	200	Drytown.....	200	Keswick.....	20	Palo Alto.....	9,550
Asti.....	100	Duncan's.....		King City.....	1,600	Paradise.....	600
Atterton.....	800	Mills.....	250	Kingston.....	100	Patterson.....	700
Auburn.....	3,000	Durham.....	600	Knights Ferry.....	200	Pebble Beach.....	300
Bancor.....	50	Dutch Flat.....	400	Knights Land- ing.....	525	Penn Grove.....	250
Banta.....	50	Dunnigan.....	150	La Fayette.....	300	Penryn.....	50
Barber.....	500	Eldridge.....	500	La Grange.....	200	Perkins.....	250
Belmont.....	1,000	El Cerrito.....	3,000	Lakeport.....	1,250	Petaluma.....	7,500
Belvedere.....	750	El Dorado.....	60	Larkspur.....	1,000	Piedmont.....	9,000
Benicia.....	2,750	Elk Grove.....	1,450	Lathrop.....	300	Pineole.....	1,000
Ben Lomond.....	500	Elmira.....	300	Lawndale.....	60	Pittsburg.....	8,500
Berkeley.....	80,000	El Verano.....	500	Lewiston.....	100	Placerville.....	2,250
Bethany.....	50	Emeryville.....	5,000	Lincoln.....	2,000	Pleasanton.....	1,800
Biggs.....	750	Empire.....	250	Live Oak.....	1,000	Plymouth.....	400
Big Oak Flat.....	150	Escalon.....	700	Livermore.....	3,600	Point Reyes.....	310
Blue Lake.....	500	Esparto.....	600	Lockeford.....	500	Port Costa.....	900
Bolinas.....	400	Eureka.....	20,000	Lockport.....	500	Port Valley.....	600
Boyds Springs.....	1,000	Fairfax.....	1,200	Loleta.....	800	Princeton.....	300
Brentwood.....	500	Field.....	1,200	Lomita Park.....	1,325	Red Bluff.....	3,500
Browns Valley.....	125	Fair Oaks.....	500	Loomis.....	500	Redding.....	5,000
Burlingame.....	13,150	Fall River.....		Los Altos.....	1,800	Redwood City.....	8,000
Burney.....	75	Mills.....	316	Los Gatos.....	4,750	Richmond.....	25,700
Butte City.....	200	Farmington.....	300	Los Molinos.....	460	Richvale.....	500
Byron.....	400	Felton.....	300	Lytton.....	100	Rio Dell.....	600
Calistoga.....	1,000	Ferndale.....	1,500	Madison.....	300	Rio Nido.....	250
Camino.....	300	Field's Land- ing.....	200	Magalia.....	100	Rio Vista.....	1,100
Campbell.....	1,500	Finley.....	100	Manteca.....	2,000	Ripon.....	1,000
Camp Meeker.....	300	Florin.....	1,400	Manion.....	65	Riverbank.....	1,200
Canby.....	500	Folsom City.....	1,500	Mare Island.....	600	Rocklin.....	700
Capitola.....	450	Forest City.....	200	Martell.....	100	Rodeo.....	900
Carlotta.....	75	Forestville.....	300	Martinez.....	7,000	Rohnerville.....	300
Carmel.....	2,500	Fortuna.....	1,200	Marysville.....	8,500	Roseville.....	7,000
Carmel High- lands.....	300	French Camp.....	200	Maxwell.....	100	Ross.....	900
Castroville.....	400	French Gulch.....	170	McArthur.....	167	Sacramento.....	105,000
Cement.....	1,000	Fresno.....	72,000	Menlo Park.....	3,500	Salida.....	300
Centerville.....	1,775	Galt.....	1,000	Meridian.....	250	Salinas.....	6,500
Ceres.....	1,100	Georgetown.....	300	Middletown.....	550	San Andreas.....	600
Chico.....	12,000	Gerber.....	400	Millbrae.....	350	San Anselmo.....	4,500
Chico Vieino.....	2,500	Gerverville.....	750	Mill Valley.....	350	San Ardo.....	300
Chualar.....	300	Gilroy.....	3,700	Mill Valley.....	3,500	San Bruno.....	2,175
Clements.....	200	Glen Ellen.....	1,200	Millville.....	200	San Carlos.....	1,300
Cloverdale.....	1,000	Gold Run.....	50	Milpitas.....	400	San Francisco.....	708,000
Colfax.....	800	Gonzales.....	500	Mission San Jose.....	500	San Jose.....	65,000
College City.....	250	Graton.....	250	Modesto.....	17,000	San Juan.....	500
Collinsville.....	300	Grass Valley.....	6,000	Mokelumne Hill.....	237	San Leandro.....	12,000
Colma.....	2,900	Greenfield.....	350	Monterey.....	6,900	San Lorenzo.....	1,000
Coloma.....	50	Gridley.....	2,500	Monte Rio.....	500	San Lucas.....	300
Columbia.....	400	Grimes.....	500	Morgan Hill.....	1,200	San Mateo.....	11,300
Colusa.....	2,200	Groveland.....	250	Mountain View.....	3,000	San Pablo.....	1,300
Concord.....	4,200	Guerneville.....	1,200	Napa.....	7,000	San Quentin.....	3,500
Copperopolis.....	300	Hamilton City.....	300	Nelson.....	50	San Rafael.....	8,500
Corcoran.....	350	Hammonon.....	500			San Clara.....	6,500
Corning.....	1,800	Hayward.....	5,000			Santa Cruz.....	17,500
Corte Madera.....	1,000	Headsburg.....	3,000			Santa Rita.....	150
Cotati.....	600	Hercules.....	600			Santa Rosa.....	14,000

Unmarked—Electricity only.

1—Gas only.

2—Gas and Electricity.

3—Gas, Electricity and Water.

4—Gas, Elect. and St. Railways

5—Electricity and Water.

6—Electricity supplied through other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.

Total Cities
 and towns
 Population
 Total Popula-
 tion Served 2,527,291



DIVIDEND DAY IS ALWAYS WELCOME!

To over one hundred thousand investors comes the pleasure of cashing the 200,000 dividend checks and 400,000 bond coupons paid annually by the **Pacific Gas and Electric Company** in return for the investment of funds in this essential and rapidly growing enterprise.

The Company's
FIRST AND REFUNDING MORTGAGE BONDS
FIRST PREFERRED STOCK
COMMON STOCK

afford desirable mediums of investment in one of the largest and soundest of the nation's public service institutions, which, with its predecessors in title, has a record of three-quarters of a century of successful operation.

RECORD OF RECENT GROWTH

	Gross Operating Revenue	Number of Customers	Sales of Electricity (K. W. H.)	Sales of Gas (Cu. Ft.)
1923.....	\$39,321,535	710,034	1,199,063,000	13,674,794,000
1924.....	44,451,586	763,617	1,334,035,000	15,277,478,000
1925.....	47,729,079	813,698	1,351,798,000	16,200,951,000
1926.....	50,960,571	874,724	1,514,981,000	17,482,206,000
1927.....	57,893,181	967,717	1,657,965,000	20,214,834,000
1928.....	61,449,592	1,004,340	1,765,767,000	21,058,369,000

PACIFIC GAS AND ELECTRIC COMPANY
 245 MARKET STREET - - - SAN FRANCISCO, CALIFORNIA

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		Red Bluff

Pacific Service Magazine

Volume XVII

Number 11

Contents for January, 1930



PICTURESQUE SOUTH POWER-HOUSE	Frontispiece
"PACIFIC SERVICE" IN THE REDWOOD	
EMPIRE—HUMBOLDT DIVISION R. G. MacDonald	331
OUR NEWLY ACQUIRED PROPERTIES—	
SNOW MOUNTAIN WATER & POWER CO. W. W. Shuhaw	342
"PACIFIC SERVICE" AND CO-OPERATION—	
BULLARD'S BAR POWER DEVELOPMENT Geo. A. Hunt	347
"PACIFIC SERVICE" AIDS INDUSTRY	
IN THE OLD TOWN OF MONTEREY	350
THE "PACIFIC SERVICE" ROLL OF HONOR	354
THE FINANCIAL SIDE OF "PACIFIC SERVICE" A. F. H.	356
EDITORIAL	358
IN MEMORIAM—JOHN A. McCANDLESS	360



Picturesque South Power-house, on South Battle Creek, Shasta Division. First award for good house-keeping among the hydro-electric plants of the "Pacific Service" system for 1929.

PACIFIC SERVICE MAGAZINE

Volume XVII

JANUARY, 1930

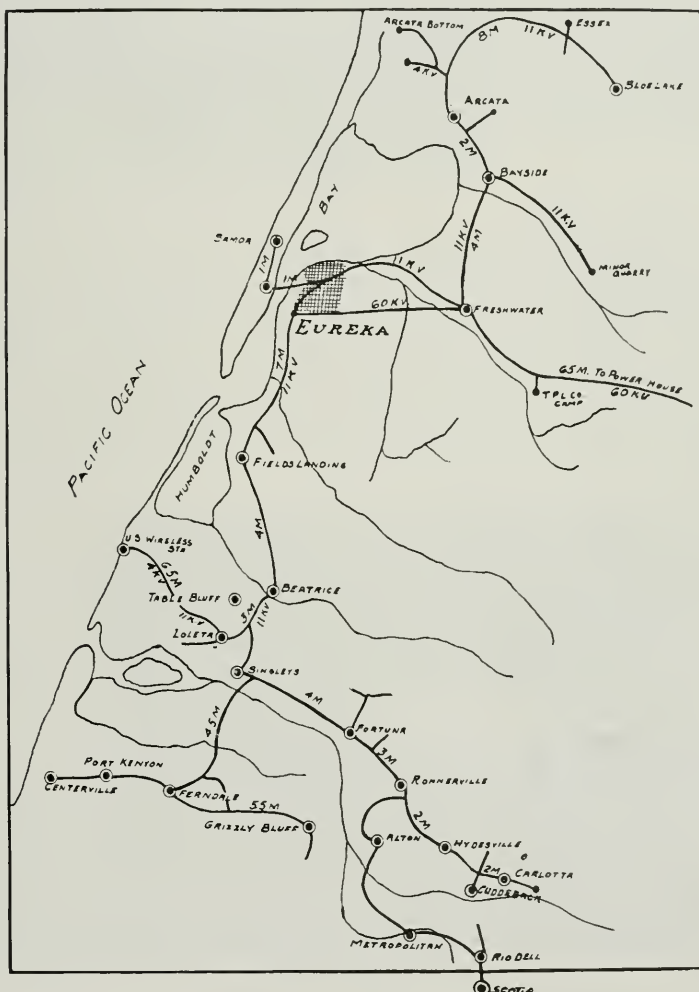
Number 11

"Pacific Service" in the Redwood Empire—Humboldt Division

By R. G. MacDONALD, Acting Manager, Humboldt Division

In the year 1927 our company acquired a controlling interest in several California public utilities among which was the Western States Gas and Electric Company. Since then the properties of that concern have been taken over completely and merged in the "Pacific Service" system.

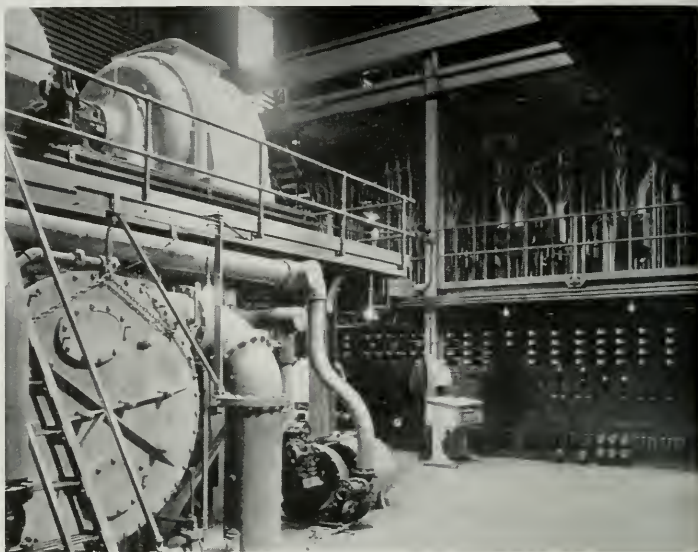
The Western States Company, at the time of purchase, operated three distinct power systems in California. One of these was known as the Eureka or Northern system, supplying the territory around Eureka on Humboldt Bay and consisting of the properties formerly owned by the Humboldt Gas and Electric Company. A description of this system, covering as it does an un-



Map of territory in Humboldt County covered by Humboldt Division.

usually picturesque as well as progressive section of Northern California, may prove of sufficient interest to engage the attention of our readers.

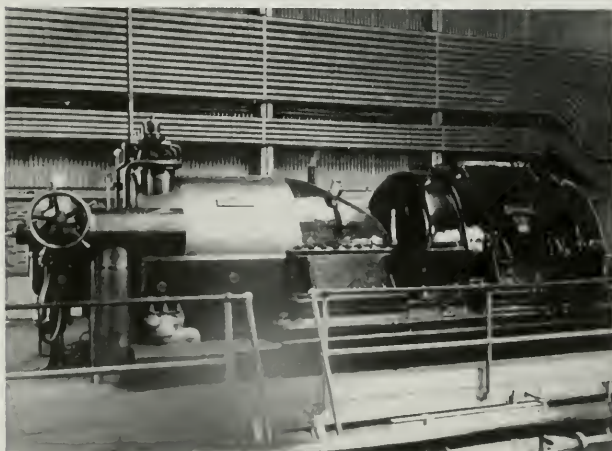
The Humboldt Gas and Electric Company was incorporated February 26, 1907. Previous to this time electric service in Humboldt County was supplied here and there by local steam plants which operated in their various restricted areas. The plant serving Eureka was established during the '80s and was of comparatively small capacity. It was known as the Humboldt Light and Power Company and was managed by the Vance Lumbering Company, which supplied waste from its nearby sawmill for fuel. In 1895 Arcata, now a thriving suburb of Eureka eight miles distant up the coast, was served with electricity by two local companies, one known as the Humboldt Manufacturing Company, the



Interior of steam-electric station at Eureka.

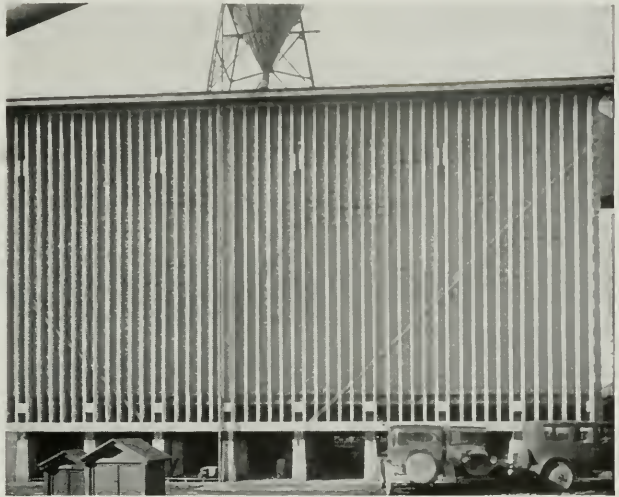
other as the Arcata Electric Light Company. In the course of years the former concern was absorbed by the latter, and the combine given the name of the Arcata Light and Power Company. In 1896 Ferndale, a town in the Eel River valley south of Eureka, received its first electricity from the Ferndale Electric Light Company. About the same time the valley country which included Fortuna, Loleta, Rohnerville, Alton, Hydesville, Carlotta and points between was served with electricity by the Humboldt Milling Company, which was later absorbed by a corporation known as the Fortuna Lighting Company. Some years later, about 1903, two sawmill operators named Theodore Minor and Isaac Minor were granted the privilege of supplying electricity in the vicinity known as Glendale and, a few miles distant, the town of Blue Lake.

All these, of course, were steam-electric plants. Hydro-electric power did not come into service until after the beginning of the



Brown-Boveri turbo-generator at Station "B."
Installed by "Pacific Service."

present century. About 1904 a number of successful lumber-mill operators banded together for the purpose of building an electric railroad from Humboldt Bay to the Sacramento Valley, with the idea of furnishing a rail outlet for finished products and providing logging railroad facilities back into the heavy timber belts. To provide electric power for the venture this association, organized as the North Mountain Power Company, procured some mining property, together with water rights on Canyon Creek, a tributary of the Trinity River some twelve miles west of Weaverville, in Trinity County, and sixty-five miles east of Eureka. A hydro-electric power plant was constructed at Junction City, utilizing a portion of the flumes and ditches of the old mining company. Two 25-cycle generators of small capacity were installed, the idea being to operate the proposed electric railroad from this source of power. At the time indicated there was no through service to Eureka on what is now the Northwestern Pacific Railroad Company's system. But just as the



Fuel house for storing saw-mill waste, at Eureka steam-electric station.

North Mountain Power Company had constructed its hydro-electric power plant at Junction City and was about to proceed further with its project renewed activities on the part of the steam railroad company from Sausalito caused a postponement of operations pending definite information concerning its plans; therefore, in order to secure an outlet for the power already available a 30,000-volt transmission line was constructed to Eureka. In the meantime, the

Humboldt Light and Power Company in Eureka had given way to a new corporation called the Eureka Lighting Company, and the arrival of hydro-electric power in that section resulted in two concerns, one steam-electric, the other hydro-electric, competing for the privilege of service in the Humboldt capital. A natural result was the organization, in 1907, of the Humboldt Gas and Electric Company, for the purpose of consolidating the Eureka Lighting Company and the North Mountain Power Company. The new concern also controlled and



Company's substation at Fortuna.

supplied power to the local systems at Ferndale, Fortuna and Arcata.

A newer and larger steam-electric plant was built in Eureka, which was given the name of Station "B," and all other steam plants were abandoned. The present steam-electric plant in Eureka occupies the same location, but aside from two boilers none of the original machinery remains, all of it having been replaced by modern steam turbines and auxiliaries. The station is rated today at 12,064 horsepower, and its most recent installation was a Brown-Boveri turbo-generator of 5,000 k.v.a. capacity, purchased and constructed in Switzerland. This up-to-date generator was contracted for by the Western States Gas and Electric Company shortly before the transfer, but was installed under "Pacific Service" management.

Early in 1911 the Western States Gas and Electric Company, which had been incorporated in the previous year by H. M. Byllesby & Company of Chicago, purchased all the lighting companies then existing in



Arcata substation—outdoor installation by "Pacific Service."

Humboldt County. The new concern proceeded to link the various towns in the county with 11,000-volt lines. Six years later, in order to effect savings in cost of power generation and in line with the conservation policy then in force, a transmission line was constructed from the Junction City plant in Trinity County to Weaverville, twelve miles to the east, where connection was made with the system of the Northern California Power Company, which was operating in Shasta and Tehama Counties and which company was absorbed later by the Pacific Gas and Electric Company. During the critical period mentioned there was an interchange of power regulated in the best interests of conservation. After the emergency passed the connection was retained and occasional interchange of power only took place until the Pacific Gas and Electric Company acquired the properties of the Western States Gas and Electric Company, when regular use of the line was re-established. This connection provides an additional source of



Ferndale substation—built by "Pacific Service."

power for Humboldt Division. At the time the connection was made, however, it was necessary to change the Junction City installation from 25 cycles to 60 cycles and step up the 30,000-volt transmission line to 60,000 volts. In addition, the line was completely reinsulated from Eureka to Weaverville.

Since the acquisition of these properties by "Pacific Service" many improvements have been made. At the Eureka station the installation of the 5,000 k.v.a. Brown-Boveri turbine already referred to has been completed. Additional improvements at the station projected for this year include the installation of two additional



Junction City hydro-electric plant on Canyon Creek, 65 miles east of Eureka.

boilers, a machine shop, additional transformer capacity, a larger exciter and improved facilities for handling fuel. In this latter connection it is interesting to note that although a certain amount of oil is used the station still relies for its main fuel supply upon lumber slashings from the nearby sawmill, which are run through a machine equipped with knives which cut the refuse up. This is called a hogging machine and the output is called hogged fuel.

A considerable portion of the transmission line between Eureka and Junction City has been reconstructed by the replacement of wooden poles by steel structures; this work is still under way. Improvements are also contemplated at the Junction City hydro-electric plant, which at the present time is rated at 2,641 horsepower generating capacity.

In the way of gas service, the first manufacturing plant in Eureka was established during the '80s by the Pacific Gas Improvement Company of San Francisco, which later disposed of its property to the Humboldt Gas and Electric Company. This plant used coal brought from Australia. Since the advent of "Pacific Service" into the territory this plant has been almost completely rebuilt. Extensive improvements and additions include a 500,000 cubic-foot holder, booster and regulating equipment, a 6-foot gas generator, oil heaters, pumps, wash boxes, scrub-



Operator's cottage, Junction City plant.

bers, oil washers, electric-driven compressor, steam-driven compressor, well pump and cement floor in the generator building.

The capacity of this plant is being brought up to 700,000 cubic feet per day.

Since our company took hold of the situation in Eureka there have been reductions in gas and electric rates. In May, 1928, a substantial reduction was made in gas rates, effecting a cut of 20 per cent in the gross revenues derived from gas sales.

Electric rates have been reduced on two occasions. The first instance benefited only large power consumers. Last July, however, a general reduction was made which involved all classes of consumers and resulted in a saving to them of approximately 20 per cent of the gross annual receipts from electric sales.

Among the prominent uses to which electricity is put in Humboldt Division are electric logging and electric gold-dredging. With regard to the former, it is a far cry from the old ox-team method of conveying logs from the woods to the mills to the present method of standard-gauge railroad construction up valleys, around switchbacks and so to extreme heights along ridges, where logs are hauled up hill by electric donkeys, loaded into cars by electric hoists and transported to the mills on the most modern steel flat cars. It is the business of "Pacific Service" to supply one of these large logging operations with the necessary electric energy.



Type of pole on transmission line. Set on top of ground and supported entirely by guy wires.

The Pacific Lumber Company, an organization of great magnitude, whose headquarters constitute the town of Scotia on Redwood Highway, thirty miles below Eureka, maintains a large logging camp on Fresh Water Creek, forty-four miles out from

Eureka in the opposite direction. Snow Camp, as it is called, is 4,500 feet in the air and is reached by railroad from the valley below. There the visitor can see electric logging at his heart's content. Trees are felled where they stand and cut and trimmed much as they used to be; but, instead of the cut logs being rolled down hill to the stream, they are now dragged up to the



Steel pipe structures replacing wooden poles on transmission line.

ridge tops by heavy steel cables pulled by powerful machines. There they are loaded onto cars, the track for which has been built along the higher elevations, and drawn to the sawmills by steam engines.

Two electrical installations have recently been put in operation by the Pacific Lumber Company at its Snow Camp plant and are served with power by "Pacific Service." They are in the nature of trial installations in that territory and are proving very interesting as well as satisfactory.



Pack train used to transport supplies and construction material along transmission line right of way.

Each installation is called a "side" and consists of a "yarder," a "loader" and one or more air compressors. The yarder is the hoist which pulls the logs up the hillsides; the loader is the one which loads them on the cars, and the air compressors supply air for the compressed-air-operated clutches and brakes. All of the machines, like their steam predecessors, are mounted on skids, for moving to various locations.

Power is taken from our company's 60,000-volt line at a point about two and one-half miles from the location of the woods operations. At this point are three 250 k.v.a., 33,000-11,000-volt, star-connected primary transformers. From here separate 11,000-volt lines are run about two and one-half miles to each "side." At the terminal of each line is a low reactance, 3-phase, 11,000-550-volt transformer, feeding the motors through steel-armored cable.

The motor equipment on one "side" is of Westinghouse manufacture and consists of one 200-300 h.p. double-wound yarding motor, which provides two speeds: two 125 h.p. loading motors, and two 15 h.p. air-compressor motors. The other "side" has General Electric equipment of one 300 h.p. yarding motor and one 15 h.p. air-compressor motor, on one skid, and two 75 h.p. loading motors with one 15 h.p. air-compressor motor on a second skid. Both yarding motors have two gear ratios, providing high and low rope speeds.



Snow conditions seasonally confront line patrolmen.

To one unfamiliar with logging operations it is hard to imagine the way the giant logs are hauled and twisted up the hillsides. The Pacific Lumber Company reports that logs up to sixty tons have been hauled up to the loading stations with no difficulty by the electric hoists. The ruggedness of present-day electrical apparatus counts heavily in an installation such as this one and goes far toward giving electricity a reputation for reliability which is so necessary in remote locations.

Over in the Junction City territory "Pacific Service" supplies power to a 500-horsepower electrically driven gold-dredger in operation on Canyon Creek, some four or

five miles from the hydro-electric plant. It is interesting to note that the ground on which this dredger is working is the original ground purchased by the North Mountain Power Company and recently sold by Pacific Gas and Electric Company to the Madrona Dredging Company.

Our company provides electric energy in Humboldt Division for many other uses, the most prominent of which are dairying, poultry-farming, irrigation, mills and manufacturing plants of various kinds.

Humboldt Division operates in one of the most romantic and picturesque sections of the Pacific coast, though, due to lack of transportation facilities, little was



Electric loading donkey at Pacific Lumber Co.'s Snow Camp.



Loading logs by electric machinery.

known of the vast resources and wonderful beauties of this section until recent years. It is interesting to note that Cape Mendocino, the most westerly point in the United States and which is in Humboldt County, was sighted by Viscaino in 1603, while Bodega reached the vicinity of Trinidad in 1775 and Russian voyagers and Hudson Bay Company trappers visited this region in 1793. Humboldt Bay was discovered in 1806 and rediscovered in 1849 by American miners and settlers. The first redwood lumber was shipped from Humboldt Bay in 1885 and the first creamery established in Ferndale in 1888. Humboldt Bay, the most important harbor between San Francisco Bay and the Columbia River, has been improved by the United States Government by the expenditure to date of approximately \$7,000,000 and offshore vessels of



Modern Humboldt dairy farm, overlooking Eel River valley.

30-foot draft can easily pass over the bar. The value of the water-borne commerce in Humboldt Bay is about \$25,000,000 annually. There is no place in the State of California where such an abundance of fishing can be found, there being considerably over 800 miles of fishing streams within the area, consisting of such major rivers as the Eel, Klamath, Trinity, Mattole, Van Duzen, Mad and Little.

The region can now be reached by rail over the Northwestern Pacific Railroad

from Sausalito or over the Redwood Highway by private conveyance or auto stage, the trip being made in about nine hours. The Redwood Highway is today complete from Sausalito to the point where it joins the Roosevelt Highway at Crescent City and the Pacific Highway at Grants Pass, Oregon, from which point Portland can be reached over excellent roads via the Pacific Highway and the Columbia River



Scene on Redwood Highway, below Eureka—Humboldt Division.

Highway. Nowhere in the United States can more beauty and diversity be found on a single highway than between Sausalito and Portland, Oregon.

There has been such a world-wide movement for the preservation of the redwoods that many parks have been set aside and dedicated to public use for all time. Some of these parks comprise the finest groves of redwood timber, and nowhere in the world can such a stretch of mammoth trees be seen. As an illustration of the gigantic size of some of them, the following is cited: a single tree found in the forest of the Little River Redwood Company had a height of 308 feet; the diameter 5 feet above ground, 20 feet, with bark, and without bark 18 feet 2 inches, and when cut produced 361,366 feet of lumber, sufficient lumber to build complete twenty-two average homes.

As an indication of the interest in the Redwood Highway taken by the people at large, it is interesting to note from figures prepared by the Chamber of Commerce in Eureka that some 375,000 people passed through the Redwood Empire during 1929, spending during such transit some \$1,500,000. All this adds very materially to the prosperity of Humboldt Division. For the convenience and comfort of the tourists passing over the Redwood Highway there have been constructed many beautiful and comfortable hotels and camp grounds, some of them being quite unique and most attractive. Some of the larger institutions are Richardson's Grove, Hartsook Inn, Benbow, which is a very delightful hotel of English architecture in a most desirable setting, Garberville, Redway, Mowatoc Hotel at Scotia, the Eureka Inn at Eureka and the Hotel Lauff at Crescent City.

Nowhere else is the sentiment expressed in Joyce Kilmer's poem "Trees" so apparent or gripping:

*I think that I shall never see
A poem lovely as a tree,
A tree whose hungry mouth is prest
Against the earth's sweet flowing breast;
A tree that looks at God all day,
And lifts her leafy arms to pray;
A tree that may in summer wear
A nest of robins in her hair;
Upon whose bosom snow has lain;
Who intimately lives with rain.
Poems are made by fools like me,
But only God can make a tree.*

In addition to the wonderful scenic beauty, the territory served by the Humboldt Division can boast a considerable diversity in a

productive way. Uplands which were never heavily timbered offer opportunities for the raising of livestock, such as sheep, goats and cattle. This has for some time constituted an important industry. During the last few years the cutover lands, which contain numerous stumps too expensive to remove for ordinary farming purposes, have been utilized by poultrymen, and while the industry is not very old the Poultry Producers' Association paid out \$350,000 to its members during the year 1929.

Contrasted with sport fishing there is a well-established, well-organized, well-managed and well-financed deep-sea fishing industry, which during the year netted 370,000 lbs. of salmon, 100,000 lbs. halibut, 28,000 lbs. perch, 30,000 lbs. smelt, 30,000 lbs. white bait, 183,000 crabs and 17,000 clams.

Lumbering, of course, occupies the dominant position in the industrial field in Humboldt County and there is sufficient timber, if cut, at its present rate, to last for considerably over one hundred years without destruction of a goodly portion of the trees along the Redwood Highway. In this connection it is only fair to the lumbering interests to point out that through their reforestation program they are planting each year approximately 1,500,000 trees. These trees will, in the course of sixty years, be of sufficient size to be commercial timber.

Redwood bark is processed to producing a base material for certain prepared, patent roofing and for insulating purposes in and around refrigeration plants and, due to its insulating properties, bids fair to compete with other materials of more expensive character.

During recent years some of the bottom land, which had formerly been used for dairy producing, very successfully raised lettuce and broccoli, the lettuce coming on the market at a time when none other was available and therefore commanding an especially high price in New York City.

The climatic conditions in this region are such that bulbs, particularly tulips, have been raised on an enormous scale and shipped to Long Island, New York, for replanting in the large estates of that section.

Humboldt County is in a fine financial condition, having a balance on hand, as of June 30, 1929, of \$1,434,822.60 and a bonded indebtedness of less than \$500.

Some years ago there was evolved by the school officials what was known as the Eu-

reka Plan in the schools. This plan has met with such favor throughout the United States that it has been reduced to print and thousands of copies have been distributed upon request. There is located in Arcata the Humboldt State Teachers' College, which institution is growing rapidly. Hardly a year passes that some new building is not erected to give additional facilities to raise the standard of the school and provide for the ever-increasing enrollment.

The lowlands around Mad River and Arcata and in the Eel River valley are very fertile and are completely occupied by dairymen, who are able to produce more butter fat from their herds than elsewhere and have been able to win the highest medals in the State of California for the quality of butter and milk produced.

The principal cities and towns served by the Pacific Gas and Electric Company in the Humboldt Division are Eureka, county seat and capital of the Redwood Empire, situated on Humboldt Bay, with a population of 20,000. It has paved streets, modern buildings, first-class hotels and has a fine educational system. Eureka's 1929-1930 building program reaches \$2,250,000.

Arcata, which lies eight miles north of Eureka on the Redwood Highway and on the north end of Humboldt Bay, with a population of 2,500, has as assets two large creameries, cooperage works, an oakex plant, is surrounded by a large agricultural area and, being the first point of contact between Trinity County over the Trinity River Highway and Humboldt Bay, is a large trading center for Trinity County back country and an outfitting post for hunters and fishermen.

Fortuna, a town of 1,500 population on the Northwestern Pacific Railroad and the Redwood Highway, is 18 miles south of Eureka and is the center of a large agricultural and timber country, having several logging operations and lumber mills tributary. It is located on Eel River, near several of the finest fishing pools.

Ferndale, with a population of 1,500, is on a paved county highway twenty-five miles south of Fernbridge, supporting one of the largest creameries in the county, together with a smaller creamery and an extremely large dairy district.

Fernbridge, a point on the Northwestern Pacific Railroad and the Redwood Highway and at the northerly end of a concrete bridge which spans Eel River and which at the

time it was built was one of the longest concrete bridges ever built, has a great deal of salmon and steelhead fishing. It is also the railroad point supplying Ferndale and will soon have in operation a modern creamery of considerable size.

Loleta, which is fifteen miles south of Eureka on the Northwestern Pacific Railroad and the Redwood Highway, supports a large milk-condensing plant. It is located in the heart of the Eel River dairy section and has been the shipping point for lettuce and broccoli during the last few years.

Blue Lake, with a population of 600, lies eight miles northeast of Arcata in the center of a large farming and dairying district and supports part of the population employed by several of the lumbering companies in the woods operations.

Alton is located on the Northwestern Pacific Railroad and the Redwood Highway some twenty-five miles south of Eureka. It boasts a cheese factory and is surrounded by a large dairy community. It also lies near the junction of the Van Duzen and Eel Rivers, which streams afford a great deal of sport fishing at that point.

Wilwood, sometimes known as Rio Dell, is a town on the west bank of the Eel River about one and one-half miles from the lumbering town of Scotia and where a portion of the residents who are in the employ of the Pacific Lumber Company at Scotia live.

Rohnerville, Hydenville and Carlotta are located on the road leading from Fortuna to Red Bluff up the Van Duzen and are centers for the dairy country surrounding each. Scotia, Samoa, Korbel and Crannell, each with nearly 1,000 inhabitants, have the four largest lumber mills of the county, the mill at Scotia being the largest in the state. Fields Landing, eight miles south of Eureka on Humboldt Bay, is the shipping point for southern Humboldt County, having both coastwise and offshore shipments.

Between the foothills of the Coast Range and the coast and for many miles up the river valleys lies an area reputed to have the most equable climate in the United States proper, though the temperature is slightly lower than some other sections of the country. On the mountain ranges and near the sources of the streams snow abounds in the winter, and summer heat is also felt. Therefore, diversity of climate can be had within one hour's auto travel over excellent secondary roads.

Our Newly Acquired Properties— Snow Mountain Water & Power Co.

By W. W. SHUHAW, Assistant Manager, North Bay Division

In September, 1929, it was officially announced at "Pacific Service" headquarters that our company had arranged to acquire all of the outstanding capital stock of the Snow Mountain Water and Power Company, a public utility operating in the area centering around Ukiah, in Mendocino county, and with transmission lines extending into Mendocino, Sonoma and Napa counties. The physical properties of this company are now operated as an integral part of the "Pacific Service" system.

The story of this water and power development dates from the beginning of the present century. At that time the city of Ukiah had trouble in supplying satisfactory electric lighting service from its small municipally owned steam plant. In addition to the inefficiency of the plant the current which it did produce was very expensive, costing the consumer \$10 per month per horsepower for the light service alone, which never exceeded 16 hours out of the 24. Furthermore, the plant was rapidly deteriorating and the Ukiah Board of Trustees

found itself confronted with the problem of raising the necessary funds for renovation and expansion. In its dilemma the board began to look around with the view of securing electric energy from some more adequate and less expensive source.

Water power development was suggested as the most satisfactory solution of the problem. Several schemes were considered. Among these was one located in Walker Valley, where the late Mr. W. W. Van Arsdale of San Francisco owned a ranch of about 15,000 acres. Mr. Van Arsdale became interested and, as a start, employed engineers to investigate a scheme to combine a number of large springs on his property from which a drop of about 1,000 feet could be obtained. After examination, however, his engineers pronounced the quantity of water insufficient to generate the amount of electric energy required by the city of Ukiah. Mr. Van Arsdale next investigated a scheme to utilize the winter flow of Walker

Valley Creek, without storage for winter service and using an auxiliary steam plant for the summer months; this, too, was pronounced impracticable by the engineers.

The attention of Mr. Van Arsdale was then called to the possibility of power development on Eel River. The plan suggested was to divert the waters of the south fork of the river at a point about 25 miles



Snow Mountain Power Plant, in Potter Valley, near Ukiah.

northeast of Ukiah and by a tunnel bored through the intervening hillside convey the flow from the dam to a projected powerhouse in Potter Valley where there is a level tract of about 5,000 acres traversed by a branch of the Russian River. This project was approved by the engineers after due examination, the result being that in February, 1905, the Eel River Power and Irrigation Com-

pany was incorporated to carry out an agreement with the Ukiah Board of Trustees whereby the new concern undertook to supply electric current for a term of years to an extent of not less than 250 horsepower for the full 24 hours of each day at a rate of \$4.00 per horse-

power per month.

Mr. Van Arsdale was president of the new company and his San Francisco business partner, Mr. George W. Scott, vice-president. They were the financial factors of the enterprise. Interested with them, but

to a lesser extent, were Messrs. H. P. Muir, R. E. Donohue, W. P. Thomas, John Cunningham and P. Connolly, of Mendocino County, and Mr. F. D. Madison of San Francisco. Water rights on Eel River to the extent of more than 75,000 inches were acquired from their various owners, lands and rights of way secured, and actual construction work was commenced early in the year 1905. Mr. A. M. Hunt,



Van Arsdale dam, on south fork of Eel River. This dam creates a forebay for Snow Mountain powerhouse in Potter Valley.



Lake Van Arsdale, looking east up Eel River Canyon.

a well-known electrical and mechanical engineer of San Francisco, was employed as consulting engineer to plan and supervise construction.

A site for the diversion dam was located at a point known as Cape Horn, where a heavy ledge of hard rock projects from the south side a considerable distance across the stream. The dam as originally planned was to be 80 or 90 feet in height with a

view to making a storage reservoir at that point of some five or six billion gallons capacity. In the meantime, however, further investigation of conditions upstream resulted in the location of a site for a much larger and more economical storage reservoir in Gravelly Valley, some 14 miles distant from the other. This discovery caused an alteration of the original plans and the height of Cape Horn dam was reduced to 40 feet above the bed of the reservoir with a view to creating at this point a forebay or balancing reservoir.

The entrance of the tunnel was located about 200 feet upstream from the Cape Horn dam. The length of this tunnel, which would pierce the divide between the Eel River and Russian River watersheds, was



The Scott dam at Lake Pillsbury.

figured at 5,800 feet. A power-house site, of about 7 acres, was located at the head of Potter Valley.

When the Eel River Power and Irrigation Company was first organized, its capital stock was \$500,000, it being thought at that time that this amount would be sufficient to put in the plant as originally contemplated. Later, however, after work was begun and further developments and examinations made it advisable to very much enlarge the original scheme, it was necessary to reorganize the company with a much larger capital. As a result, early in 1906 Senator Charles N. Felton and Mr. E. S. Pillsbury became interested with the original promoters of the scheme, and in February of that



Lake Pillsbury, major reservoir of the Snow Mountain Water & Power Company's system.

year the Snow Mountain Water and Power Company was organized with a capital of \$5,000,000. The new concern took over all of the assets and assumed all of the obligations of the Eel River Power and Irrigation Company and proceeded to construct the project on a much larger scale than originally intended.

The properties of the old company were taken over March 1, 1906, and work on power and water projects which had been begun by the latter continued until the middle of April, when, on account of the financial stringency succeeding the catastrophe in San Francisco, all work was suspended. In the fall of 1906 work was resumed and carried to completion without further interruption.

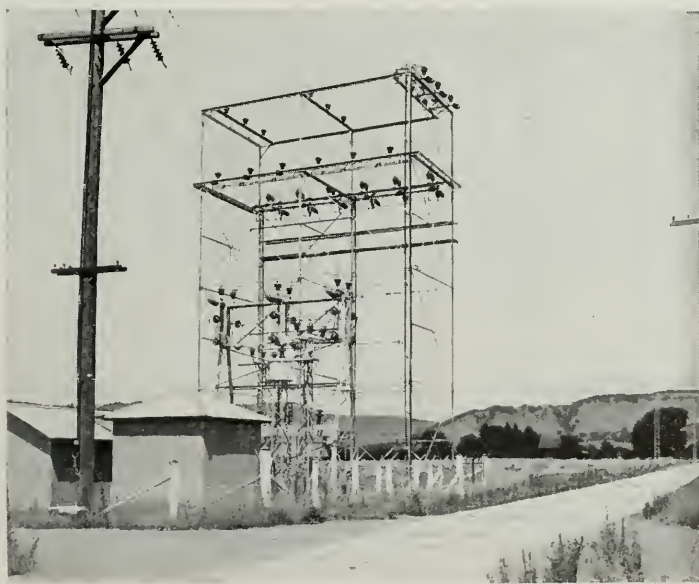
The initial installation at Potter Valley power-house consisted of two 2,000 k.v.a. Westinghouse generators. The power project as designed under the new management, exclusive of the Gravelly Valley reservoir, which was not constructed until a much later date, was completed early in 1908 and the first power was transmitted to Ukiah April 1st of that year. In September, 1908, the Snow Mountain Power Company entered into an agreement with the Pacific Gas

and Electric Company for an interchange of power which enabled the Snow Mountain Company to assure uniform service to all wholesale customers. Under this agreement a line was constructed from Ukiah to Wrights Station, near Santa Rosa, and connection established with the "Pacific Service" transmission system. This line was subsequently continued from Wrights Station to the Santa Rosa substation of the Pacific Gas and Electric Company. In 1909 the transmission lines of the company were completed from Fulton to St. Helena and down Napa Valley to Oak Knoll. The Snow Mountain company subsequently delivered electric energy to the California Telephone and Light Company, the Mount Konocti Light and Power Company, the Cloverdale Light and Power Company and the Napa Valley Electric Company. The Snow Mountain Company was never in the local distribution business but wholesaled its entire output.

Additions to the generating capacity of Potter Valley power plant were made subsequently. In March, 1910, an Allis-Chalmers 3,000 k-v-a generator was placed in service and on September 15, 1917, an Allis-Chalmers 2,000 k.v.a. generator was

installed, bringing the total plant capacity up to 9,000 k.v.a., or 12,070 horsepower, at which rating it stands today. The average annual output of the plant is about 50,000,000 kilowatt-hours.

The system receives its entire water supply from South Eel River, which rises on the west slope of the Coast Range, near the northern boundary of Lake county, and flows south and southwest about 15 miles, then westerly about the



Switching tower of Snow Mountain Water & Power Company's system, near Fulton. From this point a new steel pole line carries energy at 60,000 volts to St. Helena.

same distance to the Van Arsdale (Cape Horn) dam site. A considerable area in the southwestern part of the basin above the dam site is drained by Rice Fork of Eel River. The highest part of the whole basin is along its eastern boundary, between South Eel River and Rice Fork, where Snow Mountain reaches an elevation of 7,440 feet and Signal Peak 7,460 feet. General elevations along the eastern and northern boundaries range from 5,500 to 7,000 feet. The elevation at the point of diversion is 1,485 feet above sea level.

The 326.5 square miles of drainage basin above the Cape Horn dam is almost entirely in the California National Forest directly north of Clear Lake and about 110 miles north of San Francisco. The topography of the basin is rugged and well forested, with several level stretches along the stream.

The Cape Horn dam is a composite structure having a total length of 517½ feet. There is a concrete gravity section, 282½ feet in length, which with a bench excavated in the solid granite at one abutment forms the spillway. It is 63 feet in maximum height and is designed to pass floods to a depth of 20 feet over its crest, equivalent to a discharge of 85,000 cubic feet per second. At its south end the concrete spillway abuts against solid rock and at its north end against a heavy concrete wing wall which serves as a retaining wall for the earthfill section of the dam, which is 235 feet in length. This earthfill was constructed by the hydraulic process and is protected by a heavy riprap on both faces. In the center of the earthfill is a concrete core wall from bed-rock to the assumed high water surface about 8 feet below the top of the dam.

The reservoir created by Cape Horn dam is called Lake Van Arsdale. It serves in the capacity of a regulating forebay for Potter Valley power-plant. Its storage capacity for power use is approximately 700 acre-feet.

The entrance to the tunnel leading from Van Arsdale reservoir to Potter Valley is 25 feet below normal water level in the reservoir at a point about 200 feet upstream from the dam. The tunnel itself is 5,826 feet long and is lined throughout its entire length. It has a capacity of 350 cubic feet per second. From the outlet portion of the tunnel on the slope above Russian River, pipe lines lead direct to the units in the Potter Valley power-house, which is located upon a bench 1½ miles from the channel of

the river to which the water from the plant is conveyed through a canal.

The projected Gravelly Valley reservoir was put under construction during the summer of 1920. The site for the dam, called Scott dam after Mr. Van Arsdale's partner, was located at a point at the lower end of the valley where the elevation is 1,790 feet above sea level, 310 feet higher than the elevation at Cape Horn. It was designed as a cyclopean concrete dam, with straight crest and ogee gravity section, 105 feet above the stream bed and 805 feet in length, including a spillway section 485 feet long. The spillway section was constructed 20 feet lower in elevation than the remaining sections of the dam, affording ample capacity for the passage of the maximum flood that could generate in the watershed above it.

Scott dam was completed in December, 1921. The reservoir created by it was filled for the first time in February, 1922. It is called Lake Pillsbury. It has a maximum storage capacity of 93,000 acre-feet and floods 2,003 acres of land, submerging the former town site of Hullville. Lake Pillsbury regulates the run-off from a catchment area of 268 square miles to a minimum flow of approximately 250 second-feet. From Scott dam the water is released as required and flows down the river channel a distance of 8½ miles to Van Arsdale reservoir.

The water thus brought over from the Eel River watershed by the company has not completed its usefulness when it has passed through the power plant. Potter Valley irrigation district, embracing approximately 5,000 acres of the floor of the valley immediately below the power plant has developed a network of canals from which the entire valley can be irrigated by water purchased from the company at the power plant's tail-race. During the past irrigation season, the Potter Valley district had about 4,200 acres under cultivation, the greater part requiring irrigation. Negotiations are now under way looking toward an increase in the delivery to the district, which will need approximately 10,000 acre-feet of water each year to meet its ultimate requirements.

On December 1, 1929, Pacific Gas and Electric Company formally took over the operation of the Snow Mountain Water and Power Company's properties, and this independent company became a member of the "Pacific Service" family. The Snow Mountain system is in a growing territory and considerable expansion is anticipated.

"Pacific Service" and Co-operation— Bullard's Bar Power Development

By GEO. A. HUNT, Assistant Engineer

The Bullard's Bar development of the Pacific Gas & Electric Company is the only important example in the State of California of co-operation in the construction of a major project by mining and power interests.

The Marysville and Nevada Water and Power Company, a mining concern, owned or controlled extensive mining properties consisting principally of placer claims in the watershed of the North Yuba River, centering particularly around the Brandy City mine near Brandy City, Sierra County. To enable it to operate these properties on an extensive scale by the hydraulic process the company, under permit from the California Debris Commission, in 1919 built a 40-foot dam across the North Fork of Yuba River, near Bullard's Bar, for the impoundment of mine tailings. The reservoir thus created was filled to the crest of the dam with the mining debris that was carried down stream with the flood waters of the river during the first one or two seasons after its completion. It then became necessary for the mining company to provide additional storage space to permit of further hydraulic operations.

The Yuba Development Company, successor of the Marysville and Nevada Water & Power Company, perfected the plans for the present Bullard's Bar reservoir and power plant, which is one of the units of a comprehensive project for the ultimate complete development of the water resources of the North Yuba watershed. As mining could not alone finance such an extensive structure as the Bullard's Bar dam, in 1924, following several years of negotiation, a co-operative agreement was entered into with the Pacific Gas and Electric Company. Under this agreement the Yuba Development Company retained the right to impound 40,000,000 cubic yards of mining debris behind the dam and the Pacific Gas and Electric Company leased the reservoir and power plant and was obligated to make annual payments based approximately on the value of the power output from the plant made possible



Power-house at Bullard's Bar

by this development. These payments over the 26-year period of the agreement completely amortize the outstanding bonds which were sold to build these works. At the end of the 26-year period the Bullard's Bar dam, reservoir and power plant would become the property of the Pacific Gas and Electric Company. The total cost of the project was approximately one and one-half million dollars.

On October 7, 1929, the Pacific Gas and Electric Company bought all of the assets of the Yuba River Power Company (successor of Yuba Development Company) in

Sierra and Yuba Counties and is now sole owner of the entire development, including the mining debris storage space.

The Bullard's Bar dam is a solid concrete structure of the constant-angle arch type, topped by a roadway structure which is part of the Yuba highway running from Marysville through Downieville. The dam is 175 feet in height and, in addition to the 40,000,000 yards of mine tailing storage



Bullard's Bar dam and power-house.

space, impounds 15,000 acre-feet of water that is utilized for the generation of electric power through the Bullard's Bar and Colgate developments of the company. The reservoir created by this dam extends seven or eight miles up the North Yuba River and completely covers the former famous mining settlement known as "Bullard's Bar."

The natural flow of the North Yuba River, up to a maximum of 700 cubic feet per second, augmented by draft on the storage in the reservoir itself, passes into a penstock, 9 feet in diameter, 40 feet below the high water level of the reservoir, and is conveyed to the turbine in the Bullard's Bar power plant on the west bank of the river immediately below the dam. The small reinforced-concrete power-house structure houses a single 8,125 kva. vertical turbine and generator. Power from this plant is conveyed at 60,000 volts to Colgate power plant, whence it is transmitted into Pacific Gas and Electric Company's main system, together with the Colgate output. The water after passing through Bullard's Bar plant is returned to North Yuba River and after flowing down stream for one and one-half miles is diverted into the Colgate flume for use through the company's Colgate power plant, which is the next to the oldest plant in the system of the Pacific Gas and Electric Company. The Colgate power plant was completed on September 5, 1899, and has been in continuous operation since that date. Its output has been considerably increased by the availability of 15,000 acre-



Yuba highway to Marysville crosses over the crest of the dam.

feet of storage regulation afforded by the Bullard's Bar reservoir.

The mine tailings storage facilities afforded by Bullard's Bar reservoir are a great asset to the territory in the North Yuba watershed above the dam as the legal resumption of hydraulic mining on a large scale is now possible and the many valuable placer claims in that area can be economically operated as a result of the development. There are eight or ten mines in active operation at the present time that are dependent upon the storage reservations made under contract with this company. One concern that has contracted for over half of the total debris storage space in Bullard's Bar reservoir has just announced the commencement of extensive operations for this coming season and there are many other smaller concerns and individuals now planning to open up their claims.

The 15,000 acre-feet of stored water that will be drawn from Bullard's Bar reservoir each year has been reappropriated by the company for agricultural uses after it has passed through the Colgate plant. This amount of water is capable of irrigating about 5,000 acres of land and will normally be available for such use during the period of the year when there is insufficient natural flow in the Yuba River to supply more than the present irrigated area in the vicinity of Marysville.

The public benefits derived from the construction of the Bullard's Bar dam, therefore, are threefold. Hydraulic mining has been resumed in the North Yuba watershed, and fortunes of virgin gold can be recovered from the rich gravel deposits in Yuba and Sierra counties. About 50,000,000 kilowatt-hours of additional electric energy are available from the waters stored annually behind this dam, all of which is distributed to supply the ever-increasing demand for electricity in Northern California. And, the impoundment of water on the North Yuba is an asset to the agricultural interests of the state, as it will justify the cultivation of additional acreage of the rich areas along the Yuba River above Marysville.

The Bullard's Bar development is the first unit of a chain of projects that will harness the waters of the North Yuba River from above Sierra City down to the Narrows, a few miles above the confluence of the Yuba



Yuba River below Bullard's Bar.

River with the Feather River at Marysville, although it is improbable that any further development of the resources of that stream will be undertaken in the immediate future, due to the desirability of first completing other hydro-electric projects now under way. The economic factors of the entire plan necessitate that electric power shall stand the major cost of construction of its various units, although the erection of dams in the main river channels will provide several hundred million yards of storage space for mining debris and will result in the ultimate regulation of the stream flow of the Yuba watershed to about 1,000 cubic feet per second at the Narrows. This development will ultimately provide several times the present low flow of the river continuously during the summer and fall, and will furnish ample water for the irrigation of thousands of acres of the now unproductive lands in Yuba and Sutter counties.

"Pacific Service" Aids Industry In the Old Town of Monterey

When, upwards of a century and a half ago, Father Junipero Serra founded the first mission at Monterey and the rambling old Spanish village grew up in desultory fashion to the strumming of the guitar and the lilt-ing laughter of gaily dressed señoritas, there was no thought in anyone's mind that this beautiful spot overlooking the deep blue waters of Monterey bay would some day be the site of a great industry employing some 3,500 people and supplying the world's mar-kets with nearly a million and a half cases of sardines annually, to say nothing of 11,000 tons of fish meal for fertilizer and two and a quarter million gallons of fish oil.

Yet so it is, and Monterey marches with the times. The old town still delights the visitor from afar with its historical land-marks that recall the days of Spanish rule, but down along the water front the hum of industry tells another story.

The Monterey fisherman is an institution as old as the town, but the idea of making use of him for industrial purposes dates only from the beginning of the present century. Sardines had been canned on the Pacific Coast for a few years previous, for in 1890 the Pacific States Packing Company was

formed to pack sardines taken in San Fran-cisco Bay. The supply of fish, however, was found to be unsatisfactory and in 1909 the cannery was purchased by a company formed in San Pedro and its machinery and equipment were moved south. In 1902 Mr. F. E. Booth, realizing the importance of the sardine as a food fish, pioneered the fish-canning business in Monterey by opening up a small experimental packing shed on a back street of that town. There he canned a few sardines. His experiment was success-ful and two years later a small cannery was built upon the location now occupied by the F. E. Booth Company's plant. Following that, other enterprises of the kind were started. Their scope, however, was small, for at that time the distribution of their product was almost entirely confined to the local market.

The world war wrought the important change. Prior to 1914 canning plants throughout the country operated on but a small scale. Nearly all the sardines used in the United States and elsewhere in the world were imported, mostly from France and Norway. During the war, however, the supply that had been coming from Europe

was stopped and the de-mand for food products in the United States encour-aged the sardine canners to such an extent that sev-eral more plants were op-ened and their operations extended for purposes of export.

Today the F. E. Booth Company in Monterey operates a sardine cannery of greater production than any one such cannery in the world, its annual out-put being about 400,000 cases a year. The town of Monterey boasts of no less than 15 canneries, in all, with a total output during 1928 of, in round num-bers, 1,450,000 cases.



Looking down Cannery Row, Monterey.

Electricity has played its part in this industrial achievement. All of the Monterey canneries are electrically operated, with an aggregate connected load of 1,689 horsepower and consuming last year a total of 1,093,279 kilowatt-hours purchased from "Pacific Service." Besides, our company furnishes electric service to the American Can Company's factory in Pacific Grove nearby, whose business it is to supply cans to the fish industry in Monterey.

There the connected load is 400 horsepower. These desirable loads came to Pacific Gas and Electric Company with the purchase of the Coast Valleys Gas and Electric Company's system in 1927.

When Mr. Booth started canning he labeled his pack *mackerel*, believing that the public would not accept his goods if labeled *sardines*, as the accepted sardine was the three and four inch fish packed by the French and Norwegian canners. The F. E. Booth Company continued this for a short time until the United States Government, examining its product, established the fact that the fish being canned in Monterey was a true sardine and ruled that further packs should be so labeled. This was established after a scientific study of these fish and the establishment of the American sardine being of pilchard family like the sardines of France, Spain, Portugal and Italy. Known to science as *sardina caerulea*, it is identified by some with a similar species frequenting the west coast of South America, *sardina sagax*; its range in North American waters being from southeast Alaska to Mexico. In only a few minor features of anatomy is it distinguishable from the European variety, *sardina pilchardus*. Compared with the sardines of New England and Norway, it is altogether distinct, since Maine sardines are



Monterey Canning Company's plant, showing trucks of fried fish in the foreground.

really young herring, while the Norwegian product is of two varieties—the herring and the *bristling*, or young of the sprat, a species closely related to herring.

As a food product, however, the California sardine as customarily packed in ovals is a distinctive article. The French, Spanish, Portuguese and Italian sardines are described as the young of the pilchard; the quarter oil pack of California is of the same nature; but as a canned product the California oval pack, containing the full food value of larger and more mature fish, bears little resemblance to any of the European sardines, having special merits and attractive qualities of its own.

At the start of this industry, the fish were caught during the daylight period from sail boats, the early canneries being well supplied with a catch of from ten to fifteen tons per day. As the methods of canning improved, the amount of fish required increased until today each cannery has a capacity of from two to four hundred tons each twenty-four hours.

The fish are caught at night, the boats leaving the dock after dark and finding the fish by the phosphorescence thrown off as they move through the water. The real romance of the industry is found in Monterey as these boats leave their moorings at

dusk for the fishing banks which are situated from one to twenty miles from their home mooring. Accompanying one of these boats as they start on their night's work, with a sturdy Italian standing in the prow of the gasoline-powered launch, alert and watching for the first sign of the school of sardines, cruising along on the placid waters of Monterey Bay until in the distance, the glow of a body of fish is seen. The lookout calls to his mate, and they surge to the side, searching with experienced eyes for a school which will be worth the effort of a cast of the net. The skill of their vision is truly remarkable. To the amateur, each school of fish looks alike, but they in their wisdom will declare that the school being passed by the launch is either not of sufficient volume, or of a mixed variety of fish. They pass on until the lookout again sounds the warning and there is immediately begun the preparation for surrounding the school. In former days the fish were stored on the deck of the boat and brought to the cannery, but as methods improved and the need of larger capacities was developed, it was found necessary to tow barges in which the seined fish were stored. On the discovery of a school, the barge, or lighter, is dropped. One end of a net is secured to the lighter. The launch casting out the net, surrounds the school, and the sturdy fishermen pull in the catch and brail or scoop the sardines from the net into the lighter.

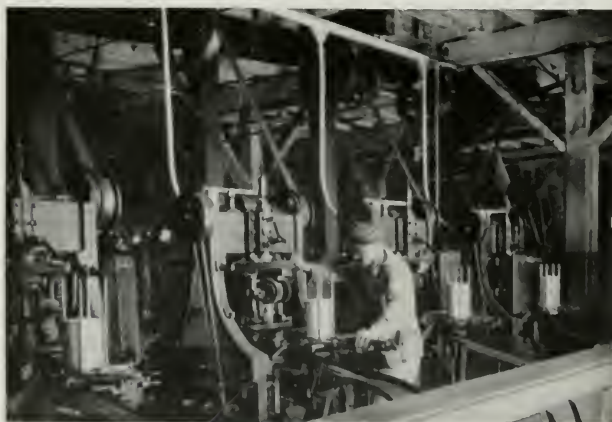
The sardines are delivered to the canneries by buckets which are lowered into the lighters over cables which are anchored from three to four hundred feet from the hoist



Stowing nets, preparatory to a night's cruise.

that elevates the buckets. Hoisted to the platform, they proceed through revolving screens, by which their scales are removed, then into flumes filled with water, where they are conveyed into tanks in front of the cutting table. The cutters, or cleaners, remove their heads and tails and clean the entrails from the fish. They are passed

on to the brine tanks where all the blood and slime are removed. Then they proceed over conveyors to the driers, where all moisture is evaporated, and then into the frying trough. The troughs are filled with boiling oil, in which the fish pass for a period of ten minutes. Emerging from the fry, they move over conveyors to the packing table, where girls in trim blue uniforms pack by hand these fish into the cans and place them on a scale to assure an equal weight in each container.



Sardine packing plant, Monterey.

Placed on the conveyor again, they are carried to the saucing machine, where the tomato sauce is added, or a mustard or spice is used. From these to the closing machine, where the top of the container is rolled on the can and hermetically sealed, the cans are carried to the cookers, where, under a steam pressure of 160 pounds, they are cooked for ninety minutes.

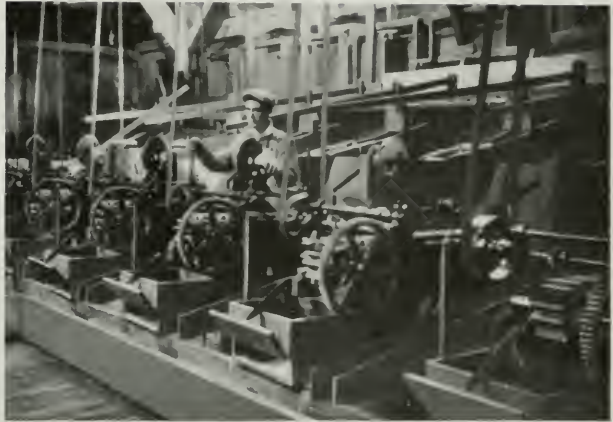
The market for California sardines has been developed to an extent that these goods go to nearly every country in the world.

An important part of the industry is the making of meal and oil from the offal of the fish.

During the season, from August to March, about 3,500 persons are employed in the canneries and the fishing fleet.

Following is a table showing the increased production in the last few years in Monterey:

Year	Cases 1-lb. Ovals	Cases Other Sizes	Tons Fish Meal	Gallons Fish Oil
1920	682,165	18,814	3,382	383,648
1921	287,954	13,003	1,577	205,159
1922	353,188	1,479	2,299	281,115
1923	580,464	10,521	3,386	557,460
1924	631,286	22,904	6,045	1,215,347
1925	737,743	37,119	6,415	1,218,993
1926	1,144,002	35,557	6,715	1,478,438
1927	1,231,470	31,027	7,873	1,506,687
1928	1,401,994	49,002	11,000	2,207,751



Automatic fish-cutting and -cleaning machines.

Monterey and the surrounding territory receive electric service from the former Coast Valleys Gas and Electric Company's system. Two pole lines operating at 22,000 volts transmit hydro-electric energy from Salinas substation to Monterey. The neighboring community of Pacific Grove is served by a 4,000-volt line from Monterey substation, while Carmel enjoys the benefit of an extension of the 22,000-volt line from Salinas.

But now the rapid growth of the Monterey peninsula, in both population and industry, calls for additional service facilities. The transformer capacity of Carmel substation has recently been raised from a rating of 1500 to one of 3,750 k.v.a. capacity. Additional feeder circuits have been installed

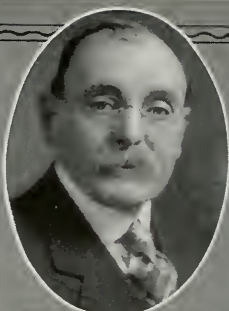
there. Then, as the load increases, it will be necessary to supply additional substation facilities at Monterey. In the way of transmission, our company's management has adopted plans for a double circuit steel pole line from Salinas which will be additional to those already in service. According to present plans, it is proposed that the new line shall operate at 22,000 volts in the beginning, the pressure to be raised to 60,000 when conditions shall warrant the change.



It takes a lot of net to surround a school of fish.



Denis Hickey



Thomas Cummins



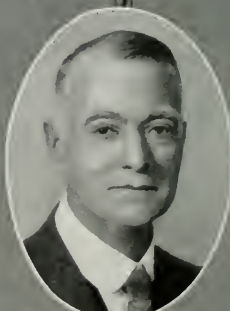
John Doherty



Otto D Druge



Jackson L. Dennis



S. F. Burger



Elmer E. Greeley



Patrick J Douglas



James E Fitzpatrick



Daniel F Reilly

The "Pacific Service" honor roll. The above portraits are of ten former employees whose long and faithful service has earned them honorable retirement.

The "Pacific Service" Roll of Honor

Heading the honor roll of "Pacific Service" are 103 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of ten portraits of our company's pensioners. These are:

Thomas Cummins. 69 years of age, having been born in December, 1860. Entered the service of the San Francisco Gas Light Company in 1889, and at the time of his retirement was employed in San Francisco Division.

Denis Hickey. 68 years of age, having been born April 6, 1861. Entered the service of the Edison Light and Power Company in October, 1908, and at the time of his retirement was employed in the Supply Department.

John Doherty. 67 years of age, having been born in June, 1862. Entered the service of the San Francisco Gas Light Company in November, 1889, and at the time of his retirement was employed in San Francisco Division.

Jackson L. Dennis. 65 years of age, having been born March 6, 1864. Entered the service of the Sacramento Gas and Electric Company in August, 1901, and at the time of his retirement was employed in Sacramento Division.

Otto D. Druge. 66 years of age, having been born October 30, 1863. Entered the service of the Central Electric Railway Company in February, 1891, and at the time of his retirement was employed in Sacramento Division.

S. F. Burger. 66 years of age, having been born November 20, 1863. Entered the service of the California Electric Light Company in May, 1888, and at the time of his retirement was employed in San Francisco Division.

Elmer E. Greeley. 66 years of age, having been born May 30, 1863. Entered the service of the Sacramento Electric, Gas and Railway Company in June, 1895, and at the time of his retirement was employed in Sacramento Division.

Patrick J. Douglas. 62 years of age, having been born October 7, 1867. Entered the service of the Suburban Light and Power Company in February, 1907, and at the time of his retirement was employed in East Bay Division.

James E. Fitzpatrick. 58 years of age, having been born February 22, 1871. Entered the service of the San Francisco Gas Light Company in June, 1891, and at the time of his retirement was employed in San Francisco Division.

Daniel F. Reilly. 49 years of age, having been born September 25, 1880. Entered the service of the American River Electric Company in November, 1907.

The Financial Side of "Pacific Service"

Following is a preliminary statement of the Company's income account for the twelve months ended December 31, 1929, compared with the corresponding period of 1928:

	12 Mos. TO DECEMBER 31ST AMOUNT	INCREASE
Gross Revenue (including Miscellaneous Income).....	\$64,819,618	\$3,031,539
Maintenance, Operating Expenses, Taxes (including Federal Taxes), Rents and Reserves for Casualties and Uncollectible Accounts	31,247,790	511,415*
Total Net Income.....	\$33,571,828	\$3,542,954
Bond Interest and Discount.....	10,353,708	305,507*
Balance.....	\$23,218,120	\$3,848,461
Reserve for Depreciation.....	7,477,634	1,510,314
Surplus.....	\$15,740,486	\$2,338,147
Dividends Accrued on Preferred Stock.....	4,896,201	213,671
Balance.....	\$10,844,285	\$2,124,476
Dividends Accrued on Common Stock.....	6,191,892	641,318
Balance.....	\$ 4,652,393	\$1,483,158

*Decrease

The Company's gross revenues from all sources aggregated \$64,819,618, a new record, exceeding by \$3,031,539 the corresponding figure for 1928.

Operating expenses, notwithstanding the net addition of 34,206 customers to the Company's distribution lines, decreased \$511,415.

For the second consecutive year there was a reduction in bond interest and discount, which aggregated \$10,353,708, or \$305,507 less than in 1928, and \$680,664 less than in 1927. The decrease in fixed charges is primarily a reflection of the refunding operations conducted in 1927 and 1928. No bonds were sold in 1929 and total fixed charges were earned 3.2 times, with a margin of \$23,218,120, indicating the exceptionally sound position of the Company's bonds.

Preferred stock dividends of \$4,896,201 were also earned 3.2 times, the balance of \$10,844,285 remaining for the common stock, after all prior deductions, amounting to \$3.50 per share upon the average of 3,095,946 shares outstanding during the year, or \$3.26 per share upon 3,329,291 fully paid and issued shares outstanding at December 31, 1929. As the proceeds from common stock sold in the last quarter of the year were still in the treasury at December 31st, this new stock money was not reflected in the earnings statement.

The year's operations may be viewed with satisfaction both by the Company's security holders and by its customers. There was a consistent growth in volume of sales, at lower average prices than in the preceding year. Kilowatt-hour sales of electricity in practically every classification showed a material increase, particularly in the field of commercial and residential heating and cooking (30.1%), lighting (12.1%), and street lighting (18.7%). These branches of electric business benefited materially from the lower rates placed in effect in the spring of 1928, and the more liberal consumption which followed that reduction encourages the belief that the further decrease in electric rates of about \$2,400,000 a

year, which becomes effective on March 1st, 1930, will also result eventually in a greater utilization of the Company's services. The same may be said of the very substantial decrease in the cost of gas service which will follow the introduction of straight natural gas in the major portion of the Company's territory during the current year.

A very brief comparative statistical summary of our 1929 operations follows:

	1929	INCREASE OVER 1928
Sales of Electricity.....	1,948,656,448 K.W. Hr.	174,434,245 K.W. Hr., or 9.83%
Connected Load.....	2,249,206 H.P.	119,345 H.P., or 5.60%
Sales of Gas.....	22,041,345,500 Cu. Ft.	982,976,800 Cu. Ft., or 4.67%
Number of Customers.....	1,038,546	34,206, or 3.41%
Number of Stockholders.....	61,131	12,063, or 24.58%

As shown in the foregoing table, the Company at the close of 1929 had 61,131 names on its stockholders' registers, an increase of 12,063, or 25%, within the year. At December 31, 1929, there were 37,116 holders of preferred stock and 24,015 common stockholders. The latter increased 5,453 notwithstanding that no public offering was made last year. This increase was due in part to the purchase and exercise of "rights" by those who were not previously holders of common stock, and in part to the wider distribution which resulted from the drastic break in general stock exchange prices in the last quarter of 1929.

Approximately \$7,250,000 of 5½% first preferred stock was sold over the counter during the year and met with an excellent distribution, averaging 35.8 shares (\$25 par value per share) for each of the 8,114 holders of this security of record at December 31.

The increase in total number of stockholders and the decrease in the average par value of stock held by them, as shown by the following figures, indicate the constant trend toward wider distribution:

	NO. OF STOCKHOLDERS	AVERAGE PAR VALUE HELD
1914 (June 3).....	3,230	\$13,090
1919.....	9,338	6,860
1924.....	31,859	3,050
1929.....	61,131	2,970

The majority of the Company's stockholders are women, as indicated by the following summary:

	NUMBER OF STOCK- HOLDERS, DEC. 31	% OF TOTAL
Men.....	23,450	38.4%
Women.....	25,595	41.9%
Joint Tenants (usually husband and wife).....	10,312	16.8%
Insurance Companies, Investment Institutions, etc.....	1,774	2.9%
Total.....	61,131	100.0%



Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE · EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII JANUARY, 1930 No. 11

The year 1930 bids fair to be one of unusual activity for the gas and electric utilities throughout the country.

In a statement recently presented to President Hoover at the White House, Mr. M. S. Sloan, President of the National Electric Light Association, estimated the expenditures contemplated by the electric light and power utilities of the country for expansion of their facilities during 1930 at \$865,000,000, an increase of \$65,000,000 over corresponding expenditures for 1929. These figures, it was explained at the time, do not include expenditures for maintenance.

The American Gas Association, through its statistical department, estimates that expenditures for construction by the manufactured and natural gas industries in the United States in 1930 will aggregate approximately \$425,000,000, an increase of about 6 per cent over the corresponding expenditures in 1929. An additional \$50,000,000 will be expended to maintain existing service facilities.

No group will do more to co-operate with President Hoover's nation-wide movement for continued business prosperity than the gas and electric utilities of California, which will continue to lead in the never-ending program of investment and expansion. In 1929 these utilities invested more millions of capital in California than ever before in their history and their pay-rolls were never larger. From their budget provisions already formulated for 1930 it would appear that new records are to be established.

Taking "Pacific Service" as an example, our company's building program for 1930 will over-top that of any past year. It will approximate \$40,000,000, of which sum \$35,000,000 will go into major gas and

electric projects and \$5,000,000 in what may be called normal extensions and additions. The company's pay-roll in 1929, including construction as well as operation, was in excess of \$19,000,000; this year it will exceed \$20,000,000, considerably more than \$1,500,000 per month. All of this money will be spent in California. It will be spread all over the northern part of the State and will be felt in every place of business, from the smallest to the largest.

Our company's greatest achievement in 1929 was the introduction of natural gas into Northern California. While this work is still in its early stages, something like \$13,000,000 has already been invested in the undertaking, principally in 286 miles of pipe line from Kettleman Hills and Buttonwillow fields into the San Francisco bay area, with branches to Fresno and Monterey. Extensions now in progress will bring natural gas service to Modesto, Stockton, Sacramento and the principal towns in Napa, Sonoma and Marin Counties. In this connection an official statement recently issued to the public press announces the completion of a contract between the Pacific Gas and Electric Company and the Standard Oil Company of California for co-operation in the construction of a second pipe line from the Kettleman Hills field to the bay area.

This joint line will travel north from Kettleman Hills through the San Joaquin Valley to Richmond, in Contra Costa County. It will vary in size from 22 to 26 inches and will be 200 miles in length. Construction is already under way and it is expected that the line will be completed and placed in operation by April 15th. The two parties to the agreement are about to organize a third company to own and operate the pipe line. It will be known as the Standard-Pacific Gas Lines, Incorporated, and will operate the pipe line for the joint account of the two companies, each of which will own one-half of the stock and will be entitled to one-half the line's capacity in natural gas transmission. The whole represents an investment of between \$8,000,000 and \$9,000,000.

In addition to the main line our company will build for its own account a 16-inch branch line, 80 miles in length, from Tracy through Stockton to Sacramento. It will also connect with the coast line to the bay already in commission by a 22-inch cross line from Tracy to Milpitas.

Our company will supply its Stockton and Sacramento Valley territory through the joint line and, also, the towns of Modesto and Tracy, where the gas systems were recently acquired. Through the Tracy-Milpitas tie-line it will take an added supply for the East Bay cities and the San Francisco peninsula. The joint line will also tie in with the Pacific Gas and Electric system at Richmond. Eventually, another branch line from Crockett, crossing the bay on the Carquinez bridge, will supply the "Pacific Service" territory in Napa, Solano and Marin Counties.

The Standard joins in the enterprise both in its own behalf and for the Pacific Public Service Company, which it controls. At the time the contract was signed the following joint statement was issued by Mr. K. R. Kingsbury, President of the Standard Oil Company of California, and our company's President, Mr. A. F. Hockenbeamer:

"The agreement reached between the two companies is in the interest of conservation and economy. It will save a duplication of pipe lines that would cost each company eight to nine million dollars, a duplication which would eventually fall upon the gas consumers of Northern California. It will also give the Standard an outlet for gas which it is now producing in the Kettleman Hills in large quantity. Making use of that gas is in itself a conservation measure of great value. Furthermore, the contract will give the Pacific Gas and Electric Company an assured gas supply and a call upon further supplies and reserves as they may be needed.

"It is the purpose of both companies to co-operate in a first-class natural gas service to Northern California. The joint line will operate to insure continuous service to all consumers, especially the domestic consumers of the Pacific Public Service Company and the Pacific Gas and Electric Company. As an example of this co-operation, it may be said that the Standard has agreed, if emergency requires it, to curtail the use of gas in its refinery at Richmond and the Pacific Gas and Electric to curtail the use of gas at its steam stations in San Francisco and Oakland. In both cases, provision will be made to use oil available as fuel until the emergency has passed.

"With two main pipe lines, the P. G. and E. line already built through the coast foothills and the joint line now being built through the valley backed by the great gas

deposits in the Kettleman Hills, Northern California is assured of one of the best and most reliable natural gas supplies in the country. The two main pipe lines will afford ample capacity for years to come and at all times one will serve as a standby to the other, and whenever the time comes to build another pipe line up the valley the two companies stand ready to build it through their subsidiary, Standard Pacific Gas Lines, Inc."

In 1930 our company expects to spend in the neighborhood of \$12,000,000 on its natural gas system. A substantial proportion of the necessary construction work should be completed by the middle of April, when San Francisco and the East Bay cities will be furnished with straight natural gas.

Natural gas means cleaner and cheaper fuel. It should attract new industries and, by reduced operating costs, permit industries already on the ground to grow and expand. We believe it will develop into a great community asset, with a distinct advertising value to Northern California. Natural gas will also benefit householders, by bringing material reductions in their monthly bills. It is estimated that this service will save domestic consumers in the "Pacific Service" territory more than \$7,000,000 a year, based on the present consumption of gas. The money so saved will be released for other purposes. It will flow into other lines of activity and stimulate business and trade.

Apart from its natural gas project our company will expend \$3,000,000 on additions to its present gas system, on new holders, on 200 or more miles of new mains and on new equipment for various plants.

On the electric side, our company in 1929 extended its vast inter-connection system into new fields, bettered its supply in old areas and strengthened its whole system with new sources of power.

The \$36,000,000 hydro-electric development on the Mokelumne was kept ahead of schedule. It is planned for completion in 1931. Salt Springs dam, the keystone of this project, when completed will be the largest rock-fill dam in the world. Work was started during the year on one of the new power-houses that will utilize the water to be impounded by the dam, also on a 20-mile concrete canal leading from the dam to the power-house. Plans are in process for construction of a 127-mile transmission line which will carry the power of the Mokelumne to our company's high-tension

distribution station at Newark, in Alameda County. The company's budget calls for an expenditure of \$16,000,000 on this project during the present year.

An intensive sales program, to offset reductions in rates, has been laid out for the present year. Our company expects to spend \$1,125,000 to develop new business. This is the largest advertising and sales promotion budget in its history.

During 1929 the electrical industry throughout the country experienced one of the greatest periods of progress in its history.

Production of electrical energy for public use totaled approximately 97,000,000,000 kilowatt hours, an increase of 9,000,000,000 kilowatt hours over 1928 and of 17,000,000,000 over 1927. This output equaled that of all the rest of the world combined.

The use of electrical power in California shows an 11 per cent increase during the past year, according to the statement of Mr. E. W. Kramer, district engineer of the Federal Power Commission.

The electrical power output of the State

reached a total of 8,900,000,000 kilowatt hours, of which 72 per cent was generated by hydro and 28 per cent by steam plants. California still greatly exceeds any state in output of hydro and is second only to New York in total output of electrical power.

President Hoover is still openly opposed to the government ownership of public utilities. In discussing the Muscle Shoals project in his recent message to Congress he said:

"I do not favor the operation by the government of either power or manufacturing business except as an unavoidable by-product of some other major public project."

Neither does the President favor undue regulation of public utilities by the Federal Government. "The nature of the electric utilities industry," he said, "is such that about 90 per cent of all power generation and distribution is intrastate in character, and most of the states have developed their own regulatory systems as to certificates of convenience, rates and profits of such utilities. To encroach upon their authorities and responsibilities would be an encroachment upon the rights of the states."

IN MEMORIAM—JOHN A. McCANDLESS

Under date of January 30th a dispatch from Honolulu announced the death at the Hawaiian capital of Mr. John A. McCandless, a member of our company's board of directors.

Mr. McCandless was a native of Virginia. At the outset of their business careers he and his brothers, James and Lincoln, took up well-boring as an occupation. While still young men they migrated to California, where they engaged in well-boring enterprises in Santa Clara and Santa Cruz counties. About 1881 they went to what were then the Sandwich Islands, where Lincoln engaged in real estate affairs, while John and James pursued their old occupation under a contract to supply well water for the irrigation of sugar plantations in the island of Oahu. They were successful and extended their activities to other islands in the Hawaiian group.

Later on Mr. John McCandless became interested in California, notably in reclamation and irrigation projects, several of which he helped to bring to successful completion. He maintained a beautiful home in Piedmont and divided his time between there and his Honolulu residence. His interests grew with the years and he became a large stockholder in Pacific Gas and Electric Company.

He was in his 77th year when he succumbed to a heart attack. He was twice married, his second wife being Miss Stella Hymson, of San Francisco, who survives him.

As a member of our company's directorate, Mr. McCandless made himself well acquainted with its working organization. He was a not infrequent attendant at company gatherings, and in his genial way made himself one of our "Pacific Service" family. He will be sincerely missed.



"PACIFIC SERVICE"

IS FURNISHED TO OVER 1,034,900 CONSUMERS OF

GAS & ELECTRICITY & WATER & STEAM

2,537,111 Total Population Served in Thirty-eight of California's Counties

CITIES AND TOWNS SERVED BY COMPANY

	DIRECTLY		INDIRECTLY		TOTAL		
	No.	Population	No.	Population	No.	Population	
Electricity	329	1,780,007	23	158,075	362	1,938,082	
Gas	87	1,806,285	5	14,702	92	1,820,987	
Water (Domestic)	25	33,500	14	22,215	28	55,775	
Railway	1	105,000			1	105,000	
Steam Heating	2	1,003,000			2	1,003,000	
Place	Population	Place	Population	Place	Population	Place	Population
Acampo.....	1,000	Corning.....	1,800	Henleyville.....	75	2 ¹ Napa.....	7,000
2 ¹ Agnew.....	125	2 ² Corte Madera.....	1,000	6 ⁷ Herules.....	600	Nelson.....	50
1 ¹ Alameda.....	35,140	2 ³ Cotati.....	600	Hickman.....	40	2 ⁴ Nevada City.....	1,800
2 ¹ Albany.....	6,000	Cottonwood.....	704	2 ¹ Hillsborough.....	1,000	Newark.....	1,100
Alamo.....	100	Coyote.....	250	6 ¹ Hollister.....	4,500	5 ¹ Newcastle.....	750
Allegany.....	300	Crockett.....	2,500	Honecut.....	500	Newman.....	1,250
5 ¹ Alta.....	100	Crows Land- ing.....	300	Hopland.....	500	Niles.....	1,850
Alton.....	200	ing.....	300	Hughson.....	625	North.....	60
Alvarado.....	1,120	2 ¹ Daly City.....	6,500	Huddell.....	200	Notoma.....	200
Alviso.....	640	Danville.....	500	Inverness.....	215	3 ¹ Novato.....	1,000
5 ¹ Amador City.....	750	Davenport.....	500	1 ¹ One.....	900	1 ¹ North Sacra- mento.....	2,500
Anderson.....	1,180	2 ¹ Davis.....	1,750	Irvington.....	1,200	mento.....	2,500
Angel Island.....	500	Dayton.....	60	5 ¹ Jackson.....	2,500	2 ¹ Oakdale.....	2,000
Antioch.....	2,800	Decoto.....	700	5 ¹ Jamesstown.....	1,000	2 ¹ Oakland.....	295,000
5 ¹ Applegate.....	100	6 ¹ Del Monte.....	300	Jenner.....	75	Oakley.....	300
6 ¹ Aptos.....	200	Denair.....	400	Jenny Lind.....	100	Occidental.....	600
Arbuckle.....	900	5 ¹ 8 Diamond Springs.....	200	Junction City.....	500	Olema.....	155
Arcata.....	2,200	Dixon.....	1,200	Kelseyville.....	600	Orland.....	2,100
Artios.....	200	Dolbins.....	100	Kennett.....	492	2 ¹ Orville.....	7,000
2 ¹ Atherton.....	800	Downville.....	350	2 ¹ Kentfield.....	1,000	Pacheco.....	300
5 ¹ Auburn.....	3,000	Drytown.....	200	Kenwood.....	300	2 ¹ Pacific Grove.....	5,000
Banzor.....	50	Duncan's Mills.....	250	Keswick.....	20	6 ¹ Palo Alto.....	9,550
Banta.....	50	2 ¹ El Cerrito.....	3,000	5 ¹ King City.....	1,600	Paradise.....	600
2 ¹ Barber.....	500	El Dorado.....	60	Kingston.....	100	Patterson.....	700
Bay.....	75	Elis Grove.....	140	Knights Ferry.....	200	2 ¹ Pebb Beach.....	300
2 ¹ Belmont.....	1,000	Elmira.....	500	Knights Land- ing.....	525	2 ¹ Penn Grove.....	250
2 ¹ Belyedere.....	750	El Verano.....	500	La Fayette.....	300	5 ¹ Penryn.....	250
Benicia.....	2,750	2 ¹ Emeryville.....	5,000	5 ¹ La Grange.....	200	Perkins.....	50
Ben Lomond.....	500	Empire.....	250	La Raport.....	1,250	2 ¹ Petalama.....	7,500
2 ¹ Berkeley.....	80,000	Escalon.....	700	2 ¹ Larkspur.....	1,000	Philo.....	50
Bethany.....	500	Esparto.....	600	Lathrop.....	300	2 ¹ Piedmont.....	9,000
Biggs.....	750	2 ¹ Eureka.....	20,000	2 ¹ Lawndale.....	60	6 ¹ Pine.....	1,000
Big Oak Flat.....	150	Fairfax.....	1,200	Lewiston.....	500	2 ¹ Pittsburg.....	8,500
Blue Lake.....	500	Fairfield.....	1,200	5 ¹ Lincoln.....	2,000	5 ¹ Placerville.....	2,250
Bodega.....	100	Fall Oaks.....	500	2 ¹ Live Oak.....	1,000	Pleasanton.....	1,800
Bolinas.....	400	Fall River.....	316	Livermore.....	3,600	Plymouth.....	400
Booneville.....	200	Farmlington.....	300	Loefelford.....	500	Point Reyes.....	310
Boyes Springs.....	1,000	6 ¹ Felton.....	300	2 ¹ Lodi.....	5,000	Potter Valley.....	990
Brentwood.....	500	Ferndale.....	1,500	Loleta.....	800	Princeton.....	300
5 ¹ Browns Valley.....	125	Field's Land- ing.....	200	2 ¹ Lomita Park.....	1,325	Red Bluff.....	3,500
2 ¹ Burlingame.....	13,150	Finley.....	100	5 ¹ Loomis.....	500	2 ¹ Redding.....	5,000
Burney.....	75	Florin.....	1,400	Los Altos.....	1,800	2 ¹ Redwood City.....	8,000
Butte City.....	200	Folsom City.....	1,500	Los Gatos.....	4,750	Redwood Valley.....	500
Byron.....	400	Forest City.....	200	Los Molinos.....	400	2 ¹ Richmond.....	28,700
Calistoga.....	1,000	Forestville.....	300	Lytton.....	100	Richvale.....	500
Camino.....	300	French Camp.....	200	Madison.....	300	Rio Dell.....	600
2 ¹ Campbell.....	1,500	French Gulch.....	170	Mazalia.....	100	Rio Nido.....	250
Camp Meeker.....	300	Fresno.....	72,000	Manteca.....	2,000	Rio Vista.....	1,100
Cana.....	500	Galt.....	1,000	Manton.....	65	Ripon.....	1,000
Capella.....	200	Georgetown.....	300	2 ¹ Mare Island.....	600	2 ¹ Riverbank.....	1,200
6 ¹ Capitola.....	450	Gerber.....	400	5 ¹ Martell.....	100	5 ¹ Rocklin.....	700
Carlotta.....	75	Geyersville.....	750	Martinez.....	7,000	6 ¹ Rodeo.....	900
Carmel.....	2,500	Gilroy.....	3,700	2 ¹ Marysville.....	8,500	2 ¹ Rollinsville.....	300
Carmel High- lands.....	300	Gold Run.....	30	Maxwell.....	600	2 ¹ Roseville.....	7,000
Castroville.....	400	5 ¹ Gold Run.....	30	McArthur.....	167	2 ¹ Ross.....	900
Cazadero.....	150	Gonzales.....	500	2 ¹ Menlo Park.....	3,500	5 ¹ Sacramento.....	105,000
Cement.....	1,000	Grainfield.....	350	Meridian.....	250	Salida.....	300
Centerville.....	1,775	2 ¹ Gridley.....	2,500	Middletown.....	580	3 ¹ Salinas.....	6,500
Ceres.....	1,100	Grimes.....	500	2 ¹ Millbrae.....	350	San Andreas.....	600
2 ¹ Chico.....	12,000	Guerneville.....	1,200	Mills.....	50	2 ¹ San Anselmo.....	4,500
Chinese Veino.....	2,500	Hamilton City.....	300	2 ¹ Mill Valley.....	3,500	San Ardo.....	200
Chinese Camp.....	300	Hammonton.....	500	Milpitas.....	400	San Bruno.....	2,175
Chualar.....	300	Hayward.....	5,000	2 ¹ Millen.....	50	San Carlos.....	1,300
Clements.....	200	Headlsburg.....	3,000	Mission San Jose.....	500	2 ¹ San Francisco.....	708,000
Cloverdale.....	1,000			Modesto.....	17,000	San Jose.....	77,820
Colfax.....	800			Mokelumne.....	237	San Juan.....	500
College City.....	250			Hill.....	237	San Leandro.....	12,000
Collinsville.....	300			2 ¹ Monterey.....	6,900	San Lorenzo.....	1,000
2 ¹ Colma.....	2,900			Monte Rio.....	500	San Lucas.....	300
5 ¹ Coloma.....	50			2 ¹ Morgan Hill.....	1,200	2 ¹ San Mateo.....	11,500
5 ¹ Columbia.....	400			Mountain View.....	3,000	San Pablo.....	1,500
2 ¹ Colusa.....	2,200			2 ¹ Mountain View.....	3,000	San Quentin.....	3,500
Concord.....	4,200			2 ¹ Eden.....	500	San Rafael.....	7,800
Copperopolis.....	300					2 ¹ Santa Clara.....	6,500
Cardelia.....	350					6 ¹ Santa Cruz.....	17,500

Unmarked—Electricity only

1—Gas only.

2—Gas and Electricity.

3—Gas, Electricity and Water.

4—Gas, Elect. and St. Railways

5—Electricity and Water.

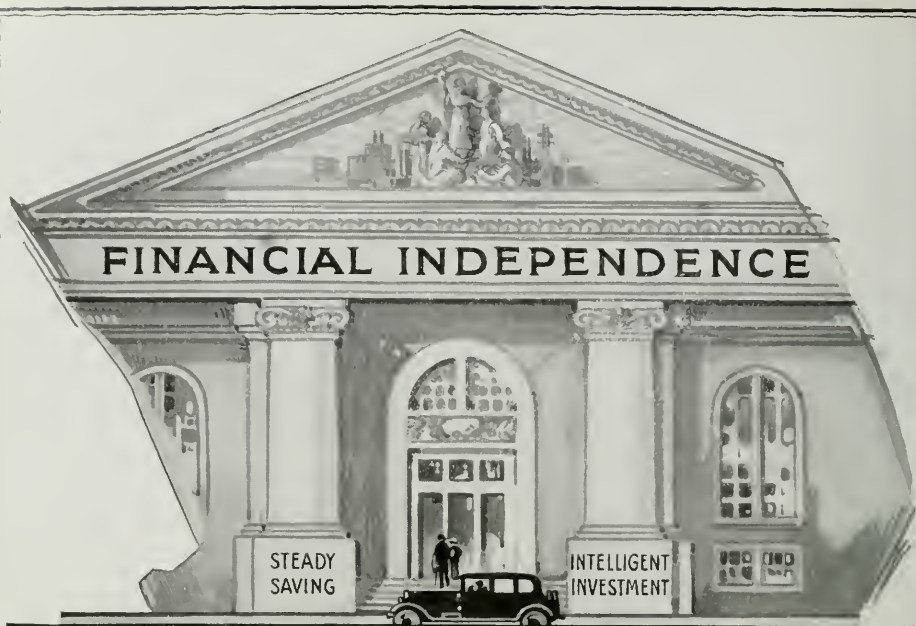
6—Electricity supplied through other companies.

7—Gas supplied through other companies.

8—Water supplied through other companies.

9—Steam Heating.

Total Cities
and towns, 2,054,672
Add Suburban
Population, 482,439
Total Popula-
tion Served, 2,537,111



Financial Independence—

rests upon the twin pillars of

Steady Saving *and* Intelligent Investment

Pacific Gas and Electric Company First Preferred Cumulative 5½% Stock is a thoroughly sound investment.

¶ It may be purchased on the partial payment plan, thus affording an ideal means of steady saving. ¶ More than 34,000 discriminating investors, in every station of life, are receiving a regular income from their holdings of the Company's First Preferred Stock. ¶ Thousands of them have thus invested their first savings. ¶ Why not lay the foundation of *your* financial independence now?

Write or telephone for circular descriptive of this investment

PACIFIC GAS AND ELECTRIC COMPANY

Stock Sales Department

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PACIFIC SERVICE MAGAZINE



MID-MARCH VIEW
AT SALT SPRINGS
CONSTRUCTION CAMP

Vol
17

APRIL 1930

No
12

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Pacific Service Magazine

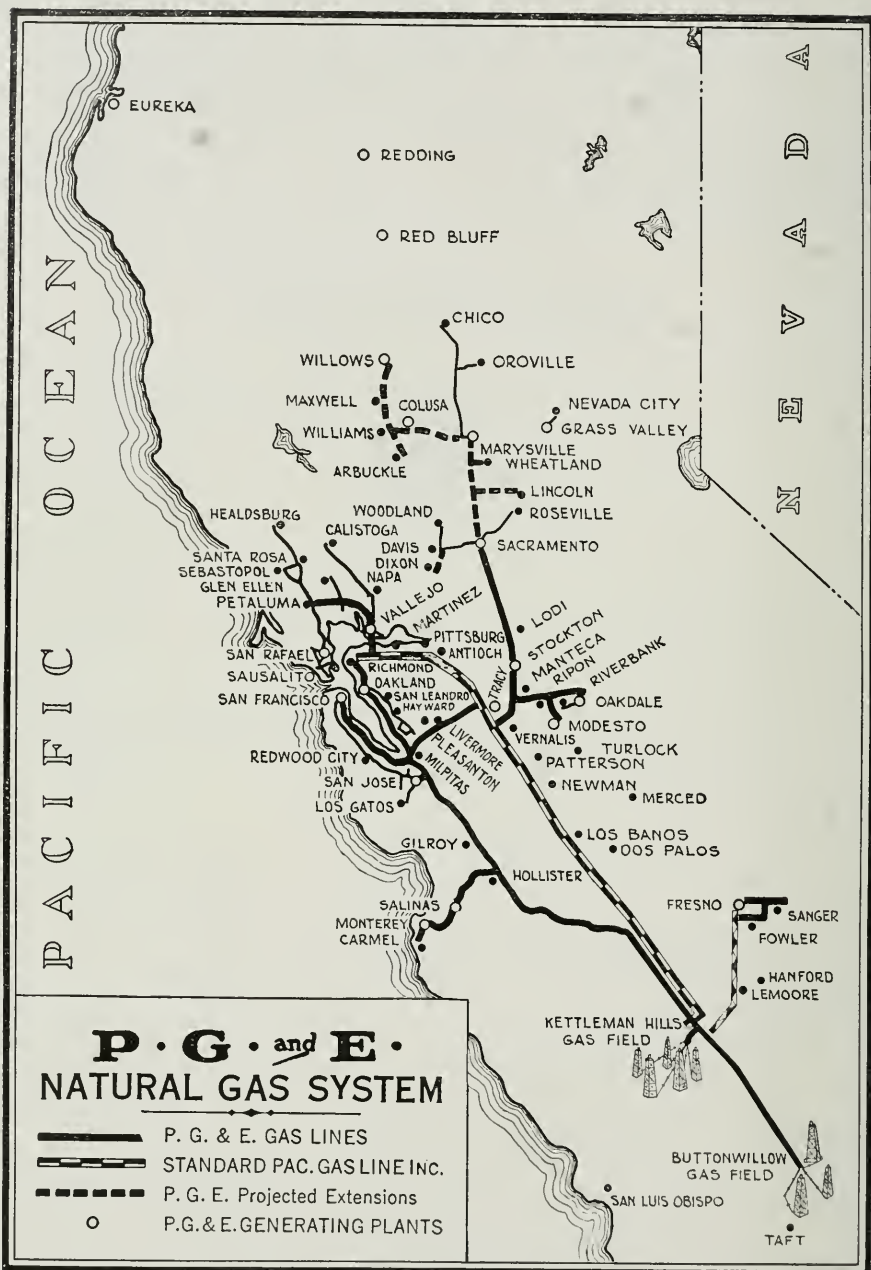
Volume XVII

Number 12

Contents for April, 1930



MAP OF OUR COMPANY'S NATURAL GAS PROJECT	·	<i>Frontispiece</i>	
THE "PACIFIC SERVICE" RECORD FOR 1929—			
INCOME ACCOUNT BEST IN COMPANY'S HISTORY—REDUCTIONS IN			
RATES OFFSET BY INTENSIVE BUSINESS DEVELOPMENT CAMPAIGN—			
IMPORTANT CONSTRUCTION WORK ACCOMPLISHED	· · · ·		363
HOW NATURAL GAS IS TRANSMITTED			
FROM VALLEY OIL FIELDS TO THE BAY	·	<i>Fred F. Doyle</i>	367
"PACIFIC SERVICE" IN SIERRA COUNTY—			
DOWNIEVILLE CONNECTED TO SYSTEM	·	<i>F. S. Myrtle</i>	378
THE ROBOT IN HYDRO-ELECTRIC			
OPERATION—SPAULDING No. 3	· · ·	<i>Elmer F. Maryatt</i>	383
THE "PACIFIC SERVICE" ROLL OF HONOR	· · · ·		386
THE FINANCIAL SIDE OF "PACIFIC SERVICE"	· ·	<i>A. F. H.</i>	388
EDITORIAL	· · · · ·		390



The company's outstanding construction accomplishment during 1929 was in the transmission of natural gas from the San Joaquin valley oil fields to the San Francisco Bay area.

PACIFIC SERVICE MAGAZINE

Volume XVII

APRIL, 1930

Number 12

The "Pacific Service" Record for 1929

Income account best in company's history. Reductions in rates offset by intensive business development campaign. Important construction work accomplished.

The best income account in the company's history. Reductions in rates for gas and electricity offset by economies of operation and the successful prosecution of an intensive business development campaign. Electric service facilities improved and extended. New properties and new territory acquired. Progress made on major developments, involving unusually large expenditures for construction work. Successful completion of the company's project for transmission of natural gas from the San Joaquin Valley oil fields to San Francisco, Oakland and the Bay area, with resultant benefit to consumers, both domestic and industrial.

The foregoing may be regarded as leading features of the "Pacific Service" record for 1929, as presented to our company's stockholders at the annual meeting held at San Francisco headquarters April 8th. The showing made therein should prove of interest to the company's customers as well as to its stockholders.

The company's gross operating revenues from all sources in 1929 aggregated \$64,440,588, thus for the twenty-fourth consecutive year since the company's incorporation establishing a new peak in the volume of business and exceeding by \$2,990,996 the gross revenues for 1928. Of this increase a sum of \$2,338,148, or almost 80 per cent, found its way into surplus, owing to reduced costs and smaller fixed charges. Of the total gross revenues the electric department was responsible for \$42,019,352, or 65.21 per cent of the whole, with an increase of \$2,960,281 over the previous year. The gas department contributed \$20,899,329, or 32.43 per cent of the total, with an increase of \$49,324 over 1928. The balance of 2.36 per cent of the company's aggregate revenues was obtained from operation of the street railway, water and irrigation and steam sales departments.

It will be observed that the increase in revenues derived from gas sales is of considerably less proportion than the normal rate of growth which this branch of the business has uniformly experienced in the past. This is attributable in part to lower gas rates which were placed in effect on February 14, 1929, as a result of reduced fuel oil prices, and by which our consumers benefited to the extent of approximately \$900,000; and in part to the substitution during the second half of the year of natural gas for manufactured gas in certain sections of the company's territory. Natural gas gives twice as much heat as the same volume of manufactured gas and the immediate effect of the substitution has been a reduction in the volume of sales and in gross receipts. This situation may be regarded as a temporary one, however. The company's management is convinced that after the necessary period of readjustment to the new conditions this natural gas venture will not only prove one of the most popular ever made from the standpoint of saving in gas bills to nearly half a million consumers but, also, will yield very satisfactory profits. Following are some of the contributing factors to this belief:

A great volume of house-heating now being done with other forms of fuel will be converted to natural gas.

A very considerable and immediate outlet for natural gas will be found among existing industries which have heretofore used less desirable or more expensive

Standard-Pacific line, to be controlled jointly by the Standard Oil Company of California and the Pacific Gas and Electric Company, each of which will own one-half interest in this new subsidiary and will be entitled to one-half of the capacity of the new pipe line. Altogether, approximately 600 miles of large capacity gas mains were constructed during 1929.

Additional gas storage capacity was provided through the erection of a 10,000,000 cubic foot holder in San Francisco, an 8,000,000 cubic foot holder in Oakland, and smaller holders in Marysville, Redding and Eureka.

Gas sales during the year aggregated 22,041,345,500 cubic feet, an increase of 982,976,800 cubic feet over the record for 1928. From August 16th to December 31st approximately 6,550,000,000 cubic feet of natural gas was received by the company's natural gas division, daily deliveries averaging 47,800,000 cubic feet, with a maximum day's delivery during this period of 68,677,000 cubic feet. At the close of the year the company had 479,986 customers for gas service, an increase of 13,358 over the previous year.

In the way of business development, aggressive sales policies in all departments were continued throughout 1929. New business estimated to yield an annual revenue of \$5,381,899 was contracted for. Coincident with the completion of the company's first natural gas pipe line a vigorous educational and sales campaign was inaugurated toward the introduction of natural gas as an industrial fuel. Several large contracts of this character were negotiated in the last few months of the year. Nine of these, located in San Francisco and the bay territory, represent an aggregate annual consumption of natural gas estimated at 2,813,885,000 cubic feet. Another extensive market for the increased use of natural gas lies in the field of domestic consumption. There are already 442,000 domestic gas consumers on the company's lines and many more will be reached through extensions to communities not hitherto served.

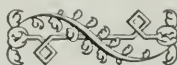
At the close of 1929 there were 12,868 employees in the company's service, of whom 4,954 had a record of five or more years of continuous employment. Salaries and wages aggregated 20,147,691, of which \$11,629,661 was paid to operating employees and \$8,518,030 to those engaged in construction work.

As of December 31, 1929, 103 retired employees of the company were receiving pensions under a system placed in effect some years ago. Pension payments in 1929 aggregated \$78,823.

The Pacific Service Employees' Association, a voluntary association of the company's employees, had a membership of 7,835 at the close of the year. The activities of this association embrace educational and social work among employees, the payment of death benefits and the rendering of temporary financial assistance in case of need.

An increasing number of employees avail themselves of the educational courses conducted by the association, 476 certificates having been issued to students completing courses in 1929. Since the inauguration of these activities several years ago the number of certificates issued totals 2,446. An employee's disability plan, with a present membership of 5,235, is conducted by the association. The amount paid in benefits during 1929 aggregated \$49,111.

President A. F. Hockenbeamer presided at the annual meeting of stockholders. Reports of progress were presented by the President and Mr. P. M. Downing, First Vice-President and General Manager. At the close of the meeting a resolution was adopted confirming the acts of the administration during the past year. Two changes were made in the directorate. Mr. John P. Coghlan, Second Vice-President, and Mr. Charles L. Barrett, Assistant Secretary, were elected to succeed Mr. John S. Drum, resigned, and Mr. John A. McCandless, deceased.



How Natural Gas is Transmitted from Valley Oil Fields to the Bay

By FRED F. DOYLE, *Manager Natural Gas Division*

Pacific Gas and Electric Company established a record for its gas construction department during 1929 when it completed its most important project for that year, namely, the construction of two hundred and eighty-five miles of pipeline for the transportation of natural gas from the San Joaquin Valley oil and gas fields to San Francisco and Oakland.

A description of this project has already appeared in previous issues of *PACIFIC SERVICE MAGAZINE*. The work was started in January, 1929, and on August 16 following the first natural gas was delivered through the system to San Francisco, thus completing the line on schedule time.

Natural gas was first used in the gas and electric plants of this company in San Francisco and Oakland to fire the boilers and also to replace oil in the manufacture of gas. The result was a reformed product, gas manufactured from natural gas, having an increased heat value over oil-gas of from ten to twelve per cent.

The company's customers were all served

until quite recently with this reformed gas. Now, however, the forces of the gas department are busily engaged in changing over these cities to straight natural gas with a heating value double that of the gas formerly manufactured from oil. At this time 54,400 of the 187,843 consumers in San Francisco and 50,000 of the 142,000 consumers in Oakland and vicinity are receiving straight natural gas and it is expected that by July 4, 1930, all will be served with it. The following communities on the company's lines are also being served with straight natural gas: Salinas, Monterey, San Jose, Santa Clara, Palo Alto, Redwood City, South San Francisco, Alameda, San Leandro, Fresno and, in addition, several smaller towns.

The gas department has set up a complete organization to take care of the huge task of converting from manufactured to natural gas. Over eight hundred men were hired and trained so as to be familiar with all makes of apparatus in order to know how to make them suitable for burning natural gas.



View of Kettleman Hills compressor plant and field headquarters.

These men are divided into groups known as "utilization crews," with a head man in charge of each crew, the men all wearing khaki uniforms with the company's name on them. Notices are sent to customers three or four days before natural gas is turned into the mains when the crews of adjusters start their rounds. Trucks loaded with orifices and other appliance parts accompany each crew to supply the adjusters with whatever is needed.

While the first line was being constructed, preparations were being made for the building of a second line from the oil fields up the west side of the San Joaquin Valley to Tracy, Martinez and Richmond. Shortly after construction of this second line was under way work was discontinued temporarily and plans changed, due to this company entering into an agreement with the Standard Oil Company of California whereby the two companies agreed to build and own jointly a line of greater capacity extending to Richmond by way of Antioch and Pittsburg. This has been given the name of the Standard-Pacific Line. It obviates the necessity of



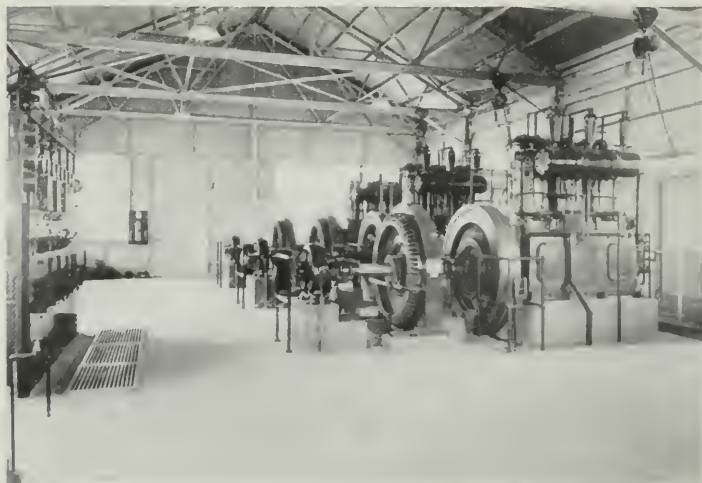
Compressor building and power-generating building. The Kettleman Hills in background.

each company building a line of its own and the economy of it will mean a considerable saving to the consumer. Pacific Gas and Electric Company is also building a line from Tracy to Milpitas which will insure a gas supply to the Bay District at all times and, also, a branch line to Stockton and Sacramento, which takes off at Vernalis on the Standard-Pacific Line, and a line across Carquinez Bridge to Vallejo and Petaluma.

This gigantic system, which will give "Pacific Service" an ultimate capacity of natural gas distribution to the Bay District of 225 million cubic feet per day, represents

a capital investment of approximately \$27,000,000. The schedule calls for natural gas to be in service to Stockton, Tracy and Milpitas by May 1, 1930, to Sacramento June 1, to Modesto July 1, while the Vallejo-Petaluma branch is to be completed by September 1, 1930.

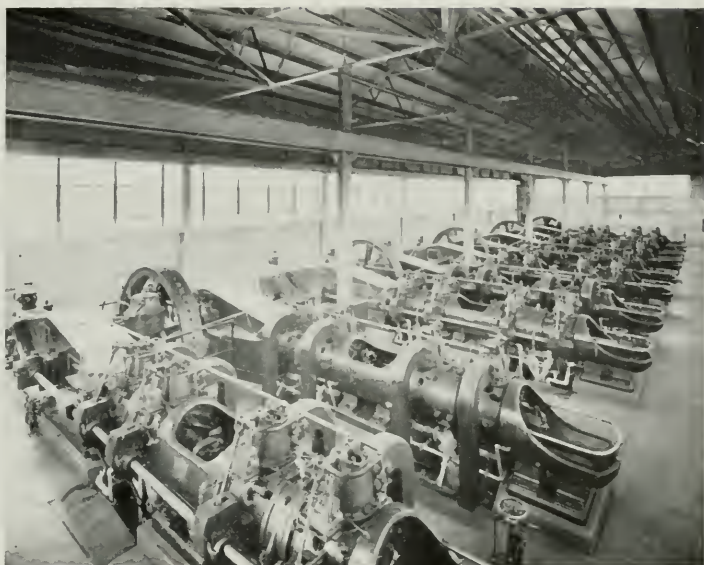
The introduction of natural gas into Northern California is the beginning of a



Kettleman Hills compressor station. Electric generating equipment.

new era for the inhabitants of that area. It not only gives the domestic customer the many advantages of this clean, economical fuel of high heating value, but makes available for industrial use a cheaper and more convenient fuel, which ultimately means growth and prosperity for the region so benefited. The aggregate saving to consumers in the territory served is estimated at \$8,000,000 annually.

The present supply of gas comes from two sources. One of these is the Buttonwillow gas field, which is located twenty-eight miles west of Bakersfield in Kern County. The wells drilled to date in this area produce dry natural gas only, that is, gas which does not contain any gasoline in vapor form. Eight wells have been completed in this field, and at the time the company commenced taking gas from them they recorded pressures, while standing shut in, that is to say, with the control valves closed, ranging from 1000 to 1075 pounds per square inch. These wells were drilled to



Compressors in Kettleman Hills station.

depths of approximately 2700 feet.

The other and main source of supply is the famous Kettleman Hills oil and gas field, located in Kings County, fifty miles northwest of the Buttonwillow district and fifty-five miles southwest of Fresno. The Milham Exploration Company succeeded in bringing in the discovery well in this field, its Elliott No. 1, on October 6, 1928. Prospecting for oil and gas had been going on in this area for twenty-two years previous, it being estimated that twenty-five miles of prospect hole had been drilled by various people before the discovery was made.

The discovery well was drilled to a depth of 7236 feet and, when completed, produced forty-two hundred barrels daily of sixty and six-tenths degrees gravity oil (almost pure gasoline) and ninety million cubic feet of natural gas with a flow pressure, at the top of the well, of 1260 lbs. per square inch. At the present time, there are five wells producing oil and gas in this field. The "shut-in" pressure has never been obtained, although pressures as high as 2360 lbs. have been recorded. It has been estimated that the closed-in pressure would be at least 3000 lbs.



Water supply station, eight miles from Kettleman Hills, in the old Tulare Lake basin.

Connected to each well in the Buttonwillow field is a drip for the purpose of collecting water or particles of sand and shale, which might come out of the well with the gas. These drips are blown each day and not only keep foreign material out of the lines but, also, aid in determining how each well is acting, that is, whether or not it is producing any water, sand or shale. The quantity of water is measured and recorded and, also, analyzed from time to time to determine, if possible, the depth of the well from which it came. This can be done by comparison with analyses previously made of water obtained from different depths.

Connected to the outlet side of the drip is a high-pressure regulator, used to reduce the well-pressure to the pressure on the com-

pany's transmission line. At present the reduction is from 1000 to 425 pounds. Before entering the transmission line the gas is measured, there being a meter for each well. From this meter to the 16-inch line, the gas passes through a 6-inch line. On the 16-inch line, at the north end of the field, is a master or check meter which measures the total amount of gas collected in that district



San Joaquin River crossing near Vernalis, west side of San Joaquin Valley.



Transmission line travels over rough country in places. The Panoche Creek territory, San Benito County.

from all the wells.

The 16-inch line extends in a northwesterly direction fifty-one miles through flat, sandy, sage-brush country, almost along a straight line to the company's Kettleman Hills compressor station. Valves of the plug type are installed in the line every five miles. On each side of these valves, there is a 6-inch plug valve connected to a riser, welded on the top of the pipe. In case of trouble, one section of the main line can be shut off by closing the 16-inch valves at each end of that section and the two 6-inch valves opened to blow the gas in the line to the atmosphere.

In the Kettleman Hills field, the oil and gas produced are run through a series of traps connected to each well, which separate the oil and the "wet" gas (natural gas containing gasoline vapors). The oil companies transport this "wet" gas to absorption plants, where the gasoline is removed, leaving the gas dry. This dry natural gas is delivered

from the outlet of the absorption plants through meters into the transmission line in such quantities as are needed. These plants operate at pressures between 425 and 460 lbs. per square inch.

The gas in the Kettleman Hills field is received from the absorption plants of the Texas Company and the Standard Oil Company. A short 16-inch line runs from each of these plants to a point where they join and, from that junction to our compressor plant. The company operates two lines, one a 16-inch, the other a 22-inch in diameter, connecting with the northern end of the 16-inch line from Buttonwillow.

The compressor plant mentioned above is, we believe, the most modern and best equipped plant of its kind in existence. It embodies the best features of compressor plant design developed to date, together with many additional features planned to make it more efficient. It is laid out in such a manner that it can be enlarged readily and economically. It will be necessary to increase its size in



Suspension bridge over Panoche Creek.



Patrol station at Antelope, near summit of Panoche Pass.

the future when the available pressures are lower and the amounts of gas to be transported are greater. At the present time, the natural pressure on the wells is sufficient to deliver the gas into our line but, in case of trouble with the wells or pipelines in the field, which would reduce the pressure available, the compressor station could be put in operation on short notice, thus insuring delivery of the required amount into the transmission line.

In the main compressor room there are five gas-engine-driven compressors of 760 horsepower each, capable of delivering 70,000,000 cubic feet of natural gas daily, with an outlet pressure of 400 lbs. per square inch. All wiring is in conduit and the vapor-proof lamps are of such intensity and so located that at night the interior is as light as day, throwing the light where needed on moving parts and eliminating shadows as much as possible.

The machinery is painted with dark green



Regulating and metering station near Milpitas, Santa Clara County.

enamel, the buildings and piping being coated with aluminum paint. A scheme for marking all pipelines with a band or bands of different colors signifying the purpose of each pipe has been carried out. For example, low-pressure and high-pressure gas lines, air lines, oil lines, water lines to and from the engines, etc., each has a distinct color band or a combination of bands so that the men operating the plant can readily identify any line on which they are working.

In order to keep the main engine room as cool as possible in the summer months, there is an open space from the main floor down to the basement floor in each side of the building, to allow free circulation of air through the basement where the hot exhaust pipes from the gas engines are located. The interior surfaces of the engine cylinders are protected by having filters placed on the air intake pipes, which will prevent grit getting into the cylinders, especially at times of high winds, which often occur in that vicinity carrying dust and sand in considerable quantities. Each compressor unit has its own lubricating-oil filtering system; in addition, there is a centrifugal oil-



Unloading pipe near Los Banos, Merced County.

cleaning system which can operate continuously, serving all five units.

In compressing the gas, it becomes heated and must be cooled before entering the transmission line; in order to do this, suitable cooling coils have been installed in redwood cooling towers. Water is circulated down through the towers like rain and, due to evaporation, is cooled. Coming in contact with the gas coils, it reduces the temperature of the gas flowing through them.

Other necessary auxiliary apparatus, such as gas-engine-driven electric generators for light and power use on the premises, water pumps, air compressors, etc., have been installed.

Other buildings have been erected on the property where the compressor station is located, to serve the operating and maintenance crews for the station and pipelines. These buildings include a machine shop, warehouse, garage and automobile repair shop, office building, chemical laboratory, dormitories for the single men, cook houses, and dwelling houses.



Wrapping pipe at Stockton for the Stockton-Sacramento line.

The living quarters have been laid out and equipped to afford every possible comfort and convenience to the employees living there. Each dwelling house is surrounded by a screen porch. The roof is elevated above the main body of the house, allowing an air space above it. These features make the living conditions much better during the periods of extreme heat in the summer. The rooms have French doors opening out on the screen porches, so that, if desired, beds or other pieces of furniture can be easily moved outside. The houses are equipped with electric lights, radiant-fire heaters with vents, gas ranges, automatic water-heaters and electric refrigerators. The roofs are covered with asbestos shingles, which not only afford fire protection but will make the

houses much cooler in summer. Picket fences surround the houses, so that each family has its own private yard. The same general style of architecture was used for the dormitories, cook house, and laboratory, to provide comfortable living and working conditions.

The cook house was designed to accommodate sixty persons if needed, and is modern in every detail. It is equipped with gas ranges and ovens, automatic water-heater, electric dish-washer, and a



Patrol station at San Martin, six miles north of Gilroy.

built-in cold storage room, with automatic refrigerating machinery. A small building separated from the cook house was constructed to provide living quarters for the cook and his help, a new feature in oil field camp design.

A tennis court and swimming pool have been provided for the use of the employees at the camp. All roads have been laid out to make all buildings accessible by automobile. Along them trees and shrubs have been planted, so that, in a couple of years, we will have a very attractive camp.

From the compressor station a 22-inch line runs northwesterly through desert country for forty-one miles to a point to which the name of Panoche Junction has been given. Here the diameter is reduced to 20-inch, the line extending over the mountains through the Panoche and Santa Clara Valleys 109 miles to the Milpitas terminal, located one mile west of the town of Milpitas in Santa Clara County. Valves have also been installed in the line north of Kettleman Station, five miles apart in the open country and from two to three miles apart through the mountains. All joints on the entire system are welded together, making one continuous line. The line is buried in the ground, the depth to the top of the pipe averaging two feet. Suspension bridges were erected to carry the



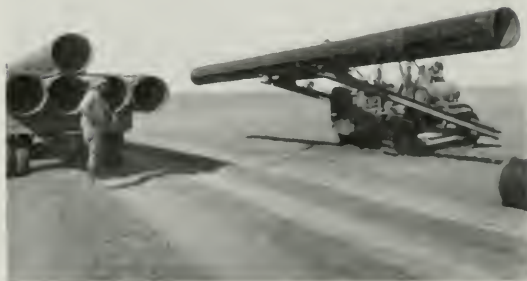
Lining and welding pipe on the 26-inch line.

line across streams or canyons where the span was great.

Several large drips have been installed in the line at points ahead of sections where the elevation rises for a long distance. These drips remove the water or light oil, which is generally carried in natural-gas transmission lines. At points where the drips collect large amounts of liquid daily, automatic bleeders have been installed. These have proven very satisfactory, as the quantity of liquid collected at other points beyond them has greatly decreased and even been reduced to nothing at some locations. They are so designed that they do not waste gas when discharging the liquid.

A pipeline maintenance and repair crew is located at our Kettleman Hills camp with automotive equipment for patrolling the right-of-way and with tools for maintaining and repairing the line.

Similar crews are located at Antelope, in the mountains about thirty miles south of the town of Hollister, in San Benito County, and at a point two miles east of the town of San Martin, near Gilroy. At each of these stations the company has erected three very comfortable cottages for the repairmen and, also, a combination garage and warehouse. Wells have been drilled to furnish the water supply at each place and the necessary water tower



Handling 26-inch pipe with tractor

and tank erected. At Antelope an automatic gas-engine-driven electric generating system operating on natural gas has been installed to furnish electric light and power for the camp. Driveways have been built at both places and, also, each property is enclosed with a standard company fence.

About two miles east of Hollister, where the line to Salinas and Monterey takes off, two cottages have been built, one for the man who attends to the regulating and metering of the gas into the branch line and the other for the foreman of the transmission line. The gas for Salinas and Monterey is odorized at this station.

At each of the stations indicating and recording pressure-gauges have been installed, giving at all times the pressure on the pipe line at that station. The charts are changed every morning and the pressure readings telephoned in to the operators at Kettleman and Milpitas, the latter telephoning them on to San Francisco, to the gas control office. These pressures are used daily to calculate the amount of gas in the line; the difference between that and the figure for the previous day is the amount of gas stored in or drawn from the line during the previous twenty-four hours. This figure must be determined in order to calculate the line loss each day. The pressure-indicators at the stations also help to locate the section of the line in which there is a break, since the drop in line-pressure in that section under those conditions is greater than the normal drop.

At the Milpitas terminal previously mentioned, regulators are used to control the pressures on the 20-inch lines leading from that station along each side of the bay to San Francisco and Oakland. At this terminal are also located large meters which measure the gas delivered into the lines. These meters are read and the amount of gas passed calculated every hour. Apparatus has been installed at this point to inject a volatile liquid with a strong odor into the gas. The purpose of this is to detect easily



Trenching machine at work in San Joaquin Valley.

any leaks, especially those in consumers' premises, and is necessary because a great percentage of the natural gas produced in the oil fields has no odor.

Five miles south of the Milpitas terminal a regulator and meter are used to supply gas to San Jose Division.

At these control stations, considerable noise is caused by the reduction of pressure of the gas passing through the regulators and meters. In order to eliminate this noise and so prevent it from being a nuisance, the apparatus and piping at these stations have been boxed in and the space around the pipe and fittings filled with sawdust, rock wool or other noise-deadening material.

The maximum daily capacity of the pipeline system in operation is 80,000,000 cubic feet, provided the maximum pressure is maintained at Kettleman Hills and the minimum pressures kept at San Francisco and Oakland for each hour of the day. The normal pressures carried are 410 lbs. per square inch at Kettleman, 150 lbs. at Milpitas and 60 lbs. at San Francisco and Oakland.

As the natural gas system must function twenty-four hours a day, it is necessary that the flow of gas be controlled in accordance with the supply and demand. At the Head Office in San Francisco is the Gas Control Office, in charge of the Chief Gas Dispatcher; there is also one man on duty each eight-hour shift during the day. There are three shift operators at Milpitas terminal,

Kettleman Hills office and at Buttonwillow.

It is necessary for the Gas Control Office to keep in touch with the gas and electric plants at San Francisco and Oakland so as to anticipate as far as possible in advance what the demand for gas will be, in order to properly control the volumes and pressures at the far end of the system.

When it is desired to reduce the pressure at San Francisco or Oakland in a short time, the Gas Control Office calls up the Milpitas operator, who cuts the flow back to the desired amount by adjusting the regulators, the change of rate being indicated by orifice meters. This causes the gas to pack in the line south from Milpitas unless the volume is to be reduced for several hours, in which case the operators in the fields are given orders to reduce the volumes taken from the plants or wells. The same process is used, of course, when the supply is to be increased. The operators at San Francisco, Milpitas and Kettleman record each hour the volumes of gas delivered and the pressures at Buttonwillow, Kettleman, Milpitas, and the gas and electric plants at San Francisco and Oakland.

During periods when work is being done on the pipeline, the Gas Control Office keeps in touch with the progress of the work and has gas drawn from the holders or the use curtailed temporarily until the line is back in service. In order not to build up too great a pressure under such conditions it is necessary, of course, for the operators in the fields to cut back the supply and stand by ready to feed gas again into the line when it is repaired and opened up for use. The Gas Control Office also knows the effect of weather changes, holidays, Sundays, etc., on the demand for gas. The amount of hydro-electric power available in the mountains also has to be watched to a certain degree, as it affects the demands for gas at the steam generating plants.

Occasionally, due to settling of the ground or the line itself or to contraction, especially when the line is new, welds at the joints break, causing a bad leak. These breaks or cracks in the welds rarely extend over one-half the circumference of the pipe. On account of the high pressures carried on the line, ranging from 425 lbs. down to 150 lbs. per sq. in., such a leak can be easily detected by the noise it causes. When the leak is discovered by the company's patrolmen, they immediately notify the San Francisco and

the Kettleman Hills offices and make arrangements to shut in a section of the line, blowing the gas in that section to the atmosphere, as previously described. After the pressure has been reduced, an excavation is made around the leak large enough to make the joint accessible for the men to work on it. If such trouble occurs during periods of peak demand for gas, the break is repaired temporarily by bolting an emergency sleeve over the pipe, this sleeve being split in halves and when placed on the pipe prevented from leaking by the use of rubber gaskets. If it is possible to keep the line out of service long enough, that is, for a period of from one to two hours, the break is welded by either the oxy-acetylene or the electric method. The gas remaining in the line after the pressure has been reduced is not purged out with air, as there is no danger of an explosion as long as a mixture of gas and air is not allowed to form within the pipe. In order to prevent an explosive mixture being accumulated, the repairmen watch the blow-off valves very carefully to see that no air enters the line. It is better to have a slight amount of gas leaking by the closed gate valves, allowing it to escape and burn where the leak is being welded, so long as the flame is not too strong. After the break has been welded, the joint is heated a dull red around the circumference of the pipe, in order to eliminate any unequal strains set up in the joint, due to the welding. After completing annealing of the joint, the pipe is allowed to cool. The repairmen again communicate with the operators at each end of the system and put the line in service by opening up the valves.

The portable electrical welding apparatus is not only used for repairing leaks but is also used in making connections to the pipeline without interrupting the flow of gas. By controlling the amperes on the machine, a pipe nipple can be welded on without burning a hole in the high-pressure pipe through which the gas would escape and become ignited. The valve is then fastened to the pipe nipple and, by the use of a special machine which fastens onto the valve, the line is tapped. With this machine the piece of metal cut out is drawn through the valve and does not fall into the pipeline.

In order to know the volumes received and delivered each day, orifice meters (the type used for measuring gas in large volumes) have been installed at each well in the

Buttonwillow field, at the gasoline plants, at the Kettleman camp and at Milpitas. Meters of the same type are located at Hollister, San Jose, and at other points along the line where gas is delivered out of the system. These meters, of course, have to be properly maintained to correctly measure the gas at all times. They are operated and read so that, before noon of each day, the amount of gas received and delivered together with the unaccounted for, is known for the previous day. Bad leaks in the line are thus often detected by excessive line loss and patrol crews sent out in search of the trouble.

The orifice meters are rather simple in construction and consist mainly of a steel plate one-quarter inch in thickness being placed in the pipeline, this plate having a circular orifice with a diameter considerably smaller than the diameter of the pipe. There is a loss of pressure caused by the gas passing through this restriction in the pipeline and, from this loss in pressure and the pressure on the pipeline which are shown on recording gauges, the amount of gas passing can be calculated. Each size orifice has a different constant which has to be determined for each meter, as it not only varies with the size of the orifice but is also affected by the temperature and the gravity of the gas. A further correction is necessary in calculating the gas measured under high pressure, as the law covering the relation between the pressure and volume of perfect gases, discovered by Boyle, the well-



Men turning pipe for electric welding.

known physicist, in 1660, does not hold, since natural gas is not a perfect gas. It is necessary to make laboratory tests in order to determine the correction factors to use for the deviation from Boyle's Law.

As the demand for natural gas in the bay region and territory adjacent to the north and east increases, additional lines, compressor stations, meter and regulator stations will be installed.

A new division of the company was created when the first section of the contemplated eight-hundred-mile pipeline system had been completed. It is known as the Natural Gas Division of the Department of Gas Construction and Operation, with headquarters in the General Office Building at San Francisco. The function of the division is to collect the natural gas from the wells or gasoline plants in the oil and gas fields where it is produced, measure and transport it to the cities and towns for distribution to consumers.



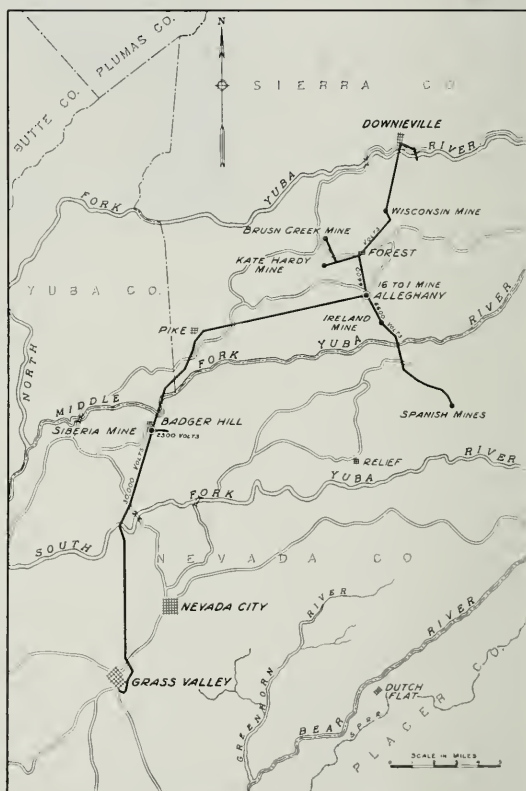
"Pacific Service" in Sierra County— Downieville Connected to System

By FREDERICK S. MYRTLE

In the fall of last year memories of early days in the Sierra Nevada region of California were revived by the extension of our company's high-tension electric transmission lines from the mining camp of Alleghany, in Nevada County, to Downieville, the county seat of Sierra County, whereby the latter picturesque old mining settlement was for the first time in its history afforded a full 24-hour service of electric energy.

On October 26th the advent of "Pacific Service" into Downieville was made the occasion of a celebration. The town turned out en masse. There was a program of congratulatory speeches in Memorial Hall in the evening, followed by a dance. The general tone was one of unqualified rejoicing.

The territory through which the "Pacific Service" transmission lines have been extended is one of unusual interest from the historical point of view, for some of the mining enterprises located there date back to the very earliest days following the discovery of gold in California. The town of Downieville nestles in a hollow at the confluence of the north and south branches of the Yuba River, at an altitude of 2,960 feet above sea level. Wooded eminences rise to great heights on either side of the Yuba Pass highway which runs through the town on its way to Nevada. The year when the first white men arrived there is not definitely known. In the "History of Sierra County," from which a part of the following is taken, it is stated that when Philo A. Haven, Carlos Haven, Warren Goodall and Thomas Angus located on Little Rich Bar, half a mile below the town of Downieville, in September, 1849, none but Indians were there,



Map of the Alleghany-Downieville territory.

but that undoubtedly white miners had visited the site early in the summer of that year.

The Yuba River proved to be immensely rich in gold in the immediate vicinity of Downieville, and as soon as this news reached the outside the rush to the new diggings began. In March, 1850, a miners' meeting was held and the extent of each mining claim fixed at 30 feet in length to each man. At that time Downieville was a city of tents, but in the fall of 1850 a man named James

Durgan built a sawmill, and board houses were constructed. The following instances are offered in proof of the richness of the river at Downieville: The Virginia Company, working just below the mouth of Slug Canyon with nine men, averaged \$2617 per day for a considerable period; the Steamboat, on what is known as Steamboat Bar, took out \$5000 per day; the Jersey Company, composed of 20 men working the river between Durgan and Jersey bridges, were in the habit of weighing their daily clean-ups on butcher's steel-yards, and their harvest ran from 20 to 60 pounds a day. The famous Tin Cup Diggings, which were situated in the river at the Blue Banks, yielded each of its three owners a tin cup full of gold every day. These accounts are all vouched for, according to local history.

The largest piece of gold found in the vicinity was discovered near Gold Bluff in 1850. It was pure gold, nearly round in shape, and weighed 25 pounds. There is a tale that a company of Frenchmen working the river at the mouth of Slate Castle, during the summer of 1851, found a piece of gold-bearing quartz which could not be moved by the combined efforts of the four men who composed the company. The lucky finders divided the chunk by cutting it into four pieces with cold chisels, and each man



Downieville, county seat of Sierra County.

took his portion and returned to France.

While there is no authentic way of determining the amount of gold mined in the immediate vicinity of Downieville up to date, a local estimate places it at about \$75,000,000.

Many men who gained great prominence in world affairs were residents of Downieville in early times. Hon. Joseph McKibben, Colonel E. D. Baker, John W. Mackay, Senator William M. Stewart, ex-Governor J. A. Johnson, Creed Haymond, Colonel Harry I. Thornton, dozens of others. Bret Harte, Mark Twain, Robert Canfield, author of "The City of Six," the scene of which is laid but three miles distant, claimed Downieville as their residence at different times. Lotta Crabtree, Lola Montez, Ned Bingham and others who afterward gained fame on the stage, all played in the theatre in Downieville.



Street in Downieville. Picturesque, if primitive.

Up to last year, however, this old-fashioned but historically prominent community enjoyed only an intermittent supply of electric service from a small water-power plant located on the left bank of the north fork of the Yuba River, in the heart of the town. This was constructed in September, 1895. The waters of the stream were diverted by means of a rock-filled timber-crib dam located about 150 feet above the power-house site and conveyed thereto by a conduit

formed by a vertical outer timber wall about 12 feet in average height, the stream bank forming the inner wall. The dam was only 15 feet high above the stream bed, and during the low-water period timber shutters three feet in height were erected along the 175-foot crest to force the water into the conduit. The power-house building was an old wooden structure 14 x 35 feet in dimension, with the generator floor at the level of the road on the stream bank. The electrical installation consisted of a single 100-kilowatt General Electric generator operated at 2,300 volts. From this energy was transmitted at the generator voltage to step-down transformers located throughout the town.

It will be seen, then, that the plant was of a very primitive type. It was owned and operated by two brothers, Con and Jerome York, and supplied night service only. The service was entirely for lighting purposes and at a flat rate based upon the number of outlets. Needless to say, it proved inadequate for a community surrounded by extensive mining enterprises whose operations would be materially facilitated by a continuous supply of electric power. Yet, so the service remained throughout the years until, in 1929, the Downieville Light and Power Company, as the pioneer enterprise was called, was taken over by Pacific Gas and Electric Company and a project of reconstruction and extension entered upon.

Of late years there has been but little activity in mining enterprises in that vicinity, mainly owing to working conditions. Some of the larger mines, however, are being operated during the summer months, and with the availability of cheap electric power better things are hoped for. Meanwhile, prospecting is carried on daily along the banks of the river with more or less success.



Bridge spanning the river at Downieville.

There is gold in plenty around there.

The Alleghany territory has been better favored in regard to electric power. The town of Alleghany lies perched upon the slope of a ridge in the heart of the Sierra Nevada mountains in the north section of Nevada County, close to the Sierra County line. It is situated at an altitude of about 4,500 feet above sea level. It is the home of the Sixteen to One mine, which is famous as one of the richest ore-producers in the country. It is surrounded on all sides by mining locations, some of which have helped to make mining history in the past. Many of these, however, have suffered from the general inactivity, though recently there have been signs of a revival of interest.

Introduction of electric power service into the Alleghany territory dates back to 1907, when Pacific Gas and Electric Company built a 30,000-volt line from old Rome power-house, on the South Yuba River a few miles from Nevada



The old court-house at Downieville.

City, to Pike City, 17 miles north of Grass Valley. This power was installed to replace a steam plant which was not only inadequate but too costly for deeper mining. With few changes this line has been in continuous service for the past twenty-two years. During 1911 our company constructed a 30,000-volt line for the account of the Middle Yuba Hydro-electric Company from Pike City to Alleghany, a distance of eight miles as the crow flies. From this point the Middle Yuba



The substation at Alleghany. 1200 k. w. capacity.

Company extended lines to various mining properties in the vicinity of Alleghany. One of these was carried through Forest City, another mining camp north of Alleghany, and thence over a mountain ridge to the Wisconsin mine, a few miles further north. A substation of 1200-kilowatt capacity was erected at Alleghany, where the transmission voltage of 30,000 was stepped down to a distribution voltage of 6600. During 1912 electric power service was extended to other mines in the vicinity. In 1926 Pacific Gas and Electric Company took over the properties of the Middle Yuba Company and all mining sections in the vicinity of Alleghany were taken care of directly by "Pacific Service."

Last year our company constructed an eight-mile line extension from Alleghany substation to Twin Sisters and Spanish mines in the Washington district of Nevada County, southwest of Alleghany. In the same year, also, came the purchase of the

Downieville properties, after which our company reconstructed the existing line between Forest City and the Wisconsin mine and built an entirely new line from that point to Downieville. There followed a complete reconstruction of the distribution system in the town.

The first mine to receive power from the new line was the Ruby mine, located between Forest City and Downieville. Our company's liberal policy in matters of rates and line extensions will undoubtedly induce a number of other promising mines in that section to connect up with "Pacific Service" this summer. Among these may be mentioned the Gold Hub, City of Six, Home-stake, Tim Dolan and others.

The new line constructed to serve the Downieville community covers a distance of approximately seven miles in a straight line over two very rough mountain ranges and through dense timber and underbrush. All of this line is at an elevation ranging from 5,000 to 6,500 feet above sea level. Some idea of the ruggedness of the country may be gathered from the fact that one gorge which is spanned by a mile of transmission line involves fifteen miles of wagon road, following the contours of the ridges. The line from Alleghany to the Spanish mine, also, was built over a very rough section of the Sierra Nevada mountains, heavily timbered and as much as 7,000 feet above sea level.

It remains to say that other extensions and improvements of service will follow with the general increase in mining activities and the resultant growth of demand for available electric power.



Staging in winter-time.

The transportation problem in the past was a series of obstacles in the way of development. Downieville is now reached by a well-constructed highway from Grass Valley, a distance of 52 miles. The way runs through Nevada City and thence due north, passing over the ridge separating the south and middle forks of the Yuba River. The middle fork is crossed shortly after passing through North San Juan, one of the oldest towns in the state and once a mining community of importance. Thence to Camptonville and over another ridge to the north fork of the river, from which point the run into Downieville is through the Yuba Pass along the banks of the stream.

Alleghany is reached by an old stage road that branches east from Camptonville and runs through Sleighville and Pike City. At Camptonville a feature of interest is a monument to Lester Allen Pelton, inventor of the Pelton waterwheel. Its invention dates from 1878. Pelton, who was a resident of Camptonville at the time, was a millwright by occupation and it occurred to him to utilize the water running into the town for power purposes. He rigged up a contrivance equipped with tin buckets and therewith operated a small motor. The power obtained was negligible in amount of horsepower but the experiment was successful as far as it went and was the nucleus of what is now a far-reaching enterprise.

Another interesting feature of Camptonville is the general store owned and run by Mr. William Meek, a stalwart citizen who has lived in that one spot since 1866. Like many others of his type he drove a stage in his time and he remembers when Camptonville was a town of 2,000 inhabitants. It is on the old emigrant trail between Downieville and Virginia City. Mr. Meek is a veritable mine of information concerning early days in that region. His reminiscences were recently collected for publication in a Sacramento newspaper.

The Alleghany stage road involves an up-and-down journey more arduous than long, and from that point the way into Downieville takes over what is called the Mountain House grade, which is quite steep in places. Four miles before reaching the county seat of Sierra the road runs through Goodyear Bar, once a prosperous mining settlement and today among the interesting relics of the past.



The Pelton monument at Camptonville.

Downieville is the quaint old one-street town that it was in the early '50's. Many of the original buildings are standing, including the Court House. In this latter building the Sheriff of the county has his official quarters. His name is George C. Byron. He is an upstanding figure of a man bronzed and hardened by a life in the out-of-doors. Before he became a county official he drove a stage between Marysville and Downieville. His great delight is to take his visitors to a room in the basement of the Court House, where he maintains an historical exhibit in the shape of a collection of deadly weapons of all shapes, sizes, ages and denominations. Each of these has its own blood-curdling history. The Sheriff also points with pride to an old wooden gallows that stands in the yard outside. There were bad men in that section in early days and many a famous malefactor met his just reward on that gruesome structure. No one has been hanged there since 1884, but it remains in its solitary glory as an awful warning to the passer-by.

The Robot in Hydro-Electric Operation—Spaulding No. 3

By ELMER F. MARYATT

Assistant Engineer, Division of Hydro-Electric and Transmission Engineering

On February 21, 1929, Spaulding No. 3 power-house, on the northwest rim of Lake Spaulding, was placed in operation. This enjoys the distinction of being the first automatically operated hydro-electric plant in the "Pacific Service" chain.

What was new yesterday is old today. General interest, not to say amazement, was aroused by the successful operation of automatic railway signals, the automatic telephone, automatic domestic appliances; now all these things are common every-day realities. Then, one day we learned that Mr. Televox had arrived from the hitherto unknown. Man himself was duplicated mechanically when Mr. Televox demonstrated that he, like any good soldier or servant, could obey and execute spoken orders. And now a contemporary of Mr. Televox is Mr. Robot, whose introduction appeared visionary in "Rossum's Universal Robots," by Karel Capek, and who today appears in the form of any mechanical device which entirely replaces the human being, relieving him of duties which he alone had been able to perform.

In a previous issue of PACIFIC SERVICE MAGAZINE there appeared an account of one of our company's electric substations which was constructed for automatic operation. But it was not until Spaulding No. 3 plant was placed in operation that Mr. Robot



Spaulding No. 3 power plant, on the north rim of Lake Spaulding—Spaulding-Drum system.

made his appearance in our system in the difficult and exacting role of an hydro-electric power-house operator. Here we have a large powerful piece of water-driven machinery, which to be automatic must start itself, bring itself up to speed, connect the electric generator to the line, adjust the amount of power it shall carry; it must also shut itself down and, coming to rest, await orders to start again.

The idea has always prevailed as one of the axioms of the operation of mechanical equipment that any type of machinery in motion would eventually destroy itself unless it were under continual human observation. The human eye, the human ear, the human senses of smell and of touch were all applied more or less continuously for the purpose of detecting the symptoms of mechanical disorder before they had time to turn into disease and destruction. Finally, this

barrier has crumbled and we find ourselves with our new fully automatic hydro-electric power station.

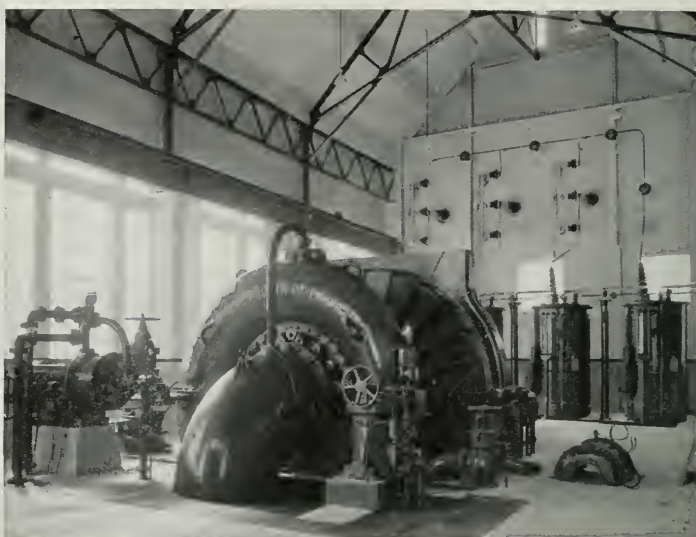
Actually, the automatic details are not new at all. It is the collective application that is new. We know that the thermometer is far more accurate than the human sense of touch; that a meter which not only registers the power passing through it but also closes its own control switch is

quicker and more accurate in its action than one which indicates but must wait for some person to read it before any action takes place. We know that any reliable instrument which is continually in service and is set and ready for action every second of the day is quicker and more dependable than an indicating instrument dependent for action on occasional human observation. Gradually we have added to our stations these instruments of protection, relieving the operator first of the necessity of periodical feeling with the hands to detect excessive temperatures, next relieving him of the necessity of periodical observation to detect excessive currents, and so on until finally he himself has been replaced by Mr. Robot.

True, the various vital parts of Mr. Robot are not assembled to resemble a human being; they are, in fact, scattered all over the station. However, their operation, considered as a whole, entirely replaces the human operator, and with a little imagination we can assume that the various pieces of equipment have absorbed the elements of Mr. Robot and that each is now able to take orders and execute them.

A knowledge of the interrelation of these elements of equipment is necessary to understand the method by which the station operates.

When a water-wheel generating unit is



Interior of Spaulding No. 3 power-house.

shut down the rotating parts are standing still and all valves are closed, shutting water off from the wheel. The switches are open, disconnecting the generator from the line. In order that the unit may start and place itself in service, it is necessary that all the various valves be opened and the switches be closed in their proper order and at the right time. If the plant is automatic these valves and switches all have to be electrically operated.

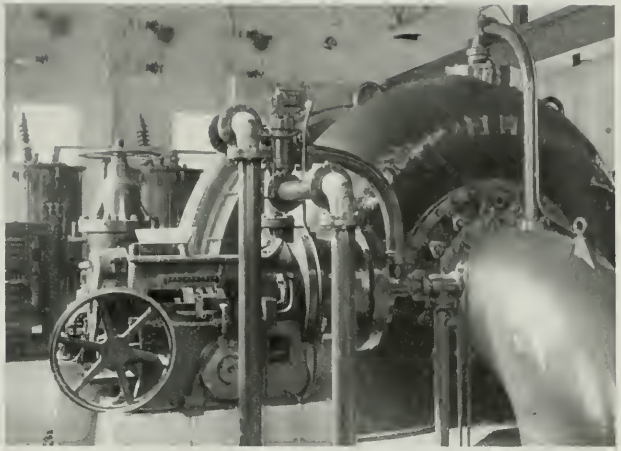
Just as we close a switch to turn on the lights or to start up the vacuum cleaner, just so can we close a similar switch to operate one of these valves or generator switches. Now, if we fasten a switch on the end of a valve in such a way that after the valve has been opened its action closes the little switch, which in turn opens another valve, and so on down the line, we have made use of the fundamental principle of the automatic power plant.

Let us visit a track meet for a moment. In a relay race, the first runner carries in his hand a small stick, and when he finishes his course he passes the stick to the next runner, and the next to the next, until finally the last runner carries the stick to the finish. If anything happens to any one of these runners or if one drops the stick the race is not completed. So it is in the automatic hydro-electric plant. If any one of Mr.

Robot's component parts fails to perform its individual function as the connection is passed along to it, the necessary preliminary work has not been accomplished and the plant does not start up.

Some one has to fire the starting gun, so to speak, by closing the first little switch. This is done by the operator at Spaulding No. 1 plant, located below Spaulding dam. He closes the line switch and so places voltage on the 60,000-volt line to Spaulding No. 3, one and one-half miles distant. The master relay at Spaulding No. 3 receives the energy and passes the connection along to the valve, which opens and so lets water flow into the water-wheel casing. As soon as the casing is filled it automatically closes a switch and passes the connection to the penstock valve, which opens gradually. After opening completely an arm closes a switch and passes the connection on to the water-wheel gates, which open and admit just enough water to start the wheel revolving and get it up to its proper speed. The proper speed being reached, the water-wheel automatically passes the connection along to the generator switch and the field switch, both of which close and so place the plant on the line ready for business.

Water flows into Spaulding No. 3 powerhouse through a penstock laid down the slope from Bowman canal, on the ridge above, under a 320-foot head. The amount of water flowing through the canal may vary widely, but Mr. Robot must be prepared to take whatever supply is available and, without wasting any of it, generate a proportionate amount of electric energy. This is accomplished by means of a float on the canal which ascertains the amount of water available and transmits the information to the water-wheel gates. These open or close in varying degree as the amount of water



Automatic hydraulic controller in power-house.

requires, but the messages are transmitted so faithfully that the water-wheel gates are held at all times in such position that no water is spilled over the canal and yet the penstock is always full.

Continuous operation of this plant by Mr. Robot depends upon the permanence of the control circuit which was completed in the starting up of the plant. This control circuit holds suspended, so to speak, the various relays or electrically operated switches, which are all ready to fall to their shut-down position the instant this circuit is broken. There are, however, in this control circuit, a number of connections that are held together by thermometers and gauges throughout the station. If any of these nerve centers experiences a temperature too hot or a pressure too great, a message of this condition is forwarded by opening the connection in the control wire. The relays fall to their original position, the starting operations are reversed and the plant is shut down. This is Mr. Robot's method of saying that he will lay off until working conditions have been improved and it is safe to start up again.

It is, perhaps, needless to say that so faithful and accurate has been Mr. Robot's vigil at Spaulding No. 3 he has won general confidence and support.





Lewis E. Luther



Frederick N. Holmes



Edward F. Cronin



Thomas Gately



John J. Lynch



Grafton G. Hillman



C.E. Hawthorne



Frank L. Harris



Louis H. Krill



William C. Foss

The "Pacific Service" honor roll. The above portraits are of ten former employees whose long and faithful service has earned them honorable retirement.

"Pacific Service" Roll of Honor

○○○○

Heading the honor roll of "Pacific Service" are 108 names of men whose long and faithful service to our company has been rewarded by their honorable retirement with provision for their declining years under our company's pension system, which underwent complete revision in the fall of 1921.

In preceding issues we presented the portraits of men whose names are upon our company's pension roll, accompanied by their several records. In doing this we were actuated by a desire to make our readers acquainted with these men and their records and to point out what is generally recognized in all up-to-date business enterprises, namely, that long and faithful service shall have its reward.

Opposite this will be found another installment of ten portraits of our company's pensioners. These are:

Frederick N. Holmes. 72 years of age, having been born December 2, 1857. Entered the service of the Valley Counties Power Company in November, 1906, and at the time of his retirement was employed in de Sabla Division.

Lewis E. Luther. 69 years of age, having been born December 4, 1860. Entered the service of the South Yuba Water Company in April, 1903, and at the time of his retirement was employed in Drum Division.

Edward F. Cronin. 69 years of age, having been born September 24, 1860. Entered the service of the Oakland Gas Light and Heat Company February 1, 1907, and at the time of his retirement was employed in East Bay Division.

John J. Lynch. 69 years of age, having been born in the year 1860. Entered the service of the San Francisco Gas Light Company in 1890, and at the time of his retirement was employed in San Francisco Division.

Thomas Gately. 68 years of age, having been born March 12, 1862. Entered the service of the Oakland Gas Light and Heat Company in January, 1906, and at the time of his retirement was employed in East Bay Division.

Grafton G. Hillman. 65 years of age, having been born May 28, 1864. Entered the service of the San Francisco Gas and Electric Company March 1, 1904, and at the time of his retirement was employed in San Francisco Division.

Frank L. Harris. 65 years of age, having been born August 24, 1864. Entered the service of the Union Construction Company in March, 1906, and at the time of his retirement was employed in San Joaquin Division.

C. E. Hawthorne. 62 years of age, having been born June 18, 1867. Entered the service of the Oakland Gas Light and Heat Company in October, 1904, and at the time of his retirement was employed in San Francisco Division.

William C. Foss. 58 years of age, having been born February 25, 1872. Entered the service of the Pacific Gas and Electric Company in May, 1908, and at the time of his retirement was employed in Sacramento Division.

Louis H. Krill. 57 years of age, having been born August 23, 1872. Entered the service of the Oakland Gas Light and Heat Company in July, 1905, and at the time of his retirement was employed in East Bay Division.

The Financial Side of "Pacific Service"

Following is a statement of the Company's income account for the first three months of 1930, compared with the corresponding period of last year:

	3 MOS. TO MAR. 31, 1930		
Gross Revenue (including Miscellaneous Income).....	\$16,467,532	Decrease	\$324,693
Maintenance, Operating Expenses, Taxes (including Federal Taxes) and Reserves for Casualties and Uncollectible Accounts.....	7,418,267	Decrease	724,898
Net Income.....	\$ 9,049,265	Increase	\$400,205
Bond Interest and Discount.....	2,504,006	Decrease	179,794
Balance.....	\$ 6,545,259	Decrease Increase	\$579,999
Reserve for Depreciation.....	1,888,546	Increase	194,842
Surplus.....	\$ 4,656,713	Increase	\$385,157
Dividends Accrued on Preferred Stocks.....	1,254,862	Increase	51,887
Balance.....	\$ 3,401,851	Increase	\$333,270
Dividends Accrued on Common Stock.....	1,894,416	Increase	468,927
Balance.....	\$ 1,507,435	Decrease	\$135,657

Electric department gross, with reduced rates in effect from March 1st, increased \$421,390 in the first quarter of 1930. Gas department gross in the same quarter fell off \$772,000. The decline in gas department gross was anticipated as a normal development following the introduction of natural gas, with twice the heat content of manufactured gas and effecting a corresponding reduction in customers' bills. As a concrete example of the effects of the substitution of natural for manufactured gas, we may cite our experience in the city of Fresno, which is an isolated unit in our distribution system and therefore affords a fair comparison. Our sales there in March, 1930, fell off almost 120,000,000 cubic feet, or about 42% compared with March, 1929, and this notwithstanding an increase of 525 consumers during the year's interval.

About 1100 men are now engaged in cutting over our consumers to natural gas and as this work proceeds, the reduction in the aggregate of customers' bills will become correspondingly larger. We expect to finish this job, the largest of its kind ever undertaken by any gas company anywhere by the end of July.

Recovery in the volume of gas sales lost by reason of the greater heat content of natural gas is progressing satisfactorily owing to the new channels of consumption which the cheaper gas has opened up. House-heating and industries are the chief of these new outlets. Quite a number of communities along the new pipe lines, heretofore without gas, will also be supplied. Approximately 3,000 household furnace installations have been sold since the first of the year, and well over a million dollars' worth of industrial gas contracts have been closed to date. The first quarter's earnings did not reflect this new business to any appreciable extent.

The total connected load at the close of March was 2,277,604 h.p., an increase of 140,805 h.p., or 6%, compared with the same date of the preceding year. New electric business signed by us since the first of the year is well ahead of last year. However, total energy output has not shown a corresponding increase. This condition is temporary, and the substantial increase in installations will undoubtedly be reflected in our income statement in due time.

Due largely to the substitution of natural gas in our own operations, expenses in the first quarter declined \$724,898, and enabled us to show an increase in net income of \$400,205. However, our investment in plants and properties as of March 31, 1930, was \$38,775,000 greater than on the corresponding date a year ago. A large part of this additional investment is in our natural gas project, which at the present time is well on towards completion in its major items.

ACQUISITION OF ADDITIONAL PROPERTIES

The Pacific Gas and Electric Company has entered into an agreement with The North American Company, New York, for the acquisition of all of the latter's public utility interests in the State of California, giving in exchange therefor 1,825,000 shares of its common stock.

Under the terms of the agreement, The North American Company undertakes:

(1) To transfer to the Pacific Gas and Electric Company \$43,886,700 par value of the common stocks of the Great Western Power Company of California, San Joaquin Light and Power Corporation and Midland Counties Public Service Corporation, representing all of the issued and outstanding common stocks of these companies except a small minority interest of \$113,300 par value of the San Joaquin Light and Power Corporation. With these stocks, control of the Feather River Power Company, California Electric Generating Company, Napa Valley Electric Company, and other minor subsidiaries, likewise passes to the Pacific Company.

(2) To transfer to the Pacific Company \$4,606,100 par value of 7% preferred stock and \$146,200 par value of 6% preferred stock of the San Joaquin Light and Power Corporation and Midland Counties Public Service Corporation.

(3) To cancel all advances made up to February 1st, 1930, by The North American Company to its California subsidiaries for construction purposes. These advances aggregate \$19,180,777, and have been carrying 6% interest.

The aggregate par value of the foregoing stocks and advances is \$67,819,777, against which the par value of Pacific Gas common stock to be issued will amount to \$45,625,000. The consolidation will, therefore, result in a substantial reduction of outstanding capitalization.

The various properties which will pass under control of the Pacific Company if the agreement with The North American Company is finally consummated had outstanding on January 31st, 1930, in the hands of the public \$89,803,350 par value of bonds and \$37,515,600 of preferred stocks. These preferred stocks are widely distributed among approximately 25,000 investors, of whom 95 per cent live in California, mainly in the territory served by the companies.

It is anticipated that Pacific Gas and Electric Company, following its past policy of keeping its corporate, financial and operating structures as simple as possible, will in due time acquire the fee-title to all the properties involved in the present transaction. This would involve the retirement of the \$37,515,600 of preferred stocks. While no definite plans have been worked out, it is quite likely that the retirement will be effected by offers of exchange for Pacific Gas and Electric Company preferred stock.

Through this transaction, The North American Company becomes the largest single stockholder of Pacific Gas and Electric Company, with the ownership of approximately 20 per cent of all of the latter's outstanding common and preferred stocks, both of which have voting power, and approximately 32 per cent of its outstanding common stock. These percentages are based on the present outstanding capitalization of the Pacific Company. Upon conversion of the preferred stocks above referred to, The North American Company's representation will be about 17 per cent of total stock. These conversions will bring the number of stockholders of the Pacific Company up to more than 85,000.

The consolidation of the California properties of The North American Company with those of the Pacific Gas and Electric Company will considerably enlarge the field of operations of the latter, forming a compact and well co-ordinated system serving a territory of approximately 75,000 square miles. A brief description of the physical properties of the acquired companies appears elsewhere in this magazine. A statistical summary of the 1929 operations of the consolidated system follows:

Gross revenue.....	\$87,274,000
Capacity of electric generating plants.....	1,473,000 h.p.
Sales of electricity.....	3,188,000,000 k.w.h.
Sales of gas.....	23,158,000,000 cu. ft.
Number of electric customers, Dec. 31, 1929.....	709,442
Number of gas customers, Dec. 31, 1929.....	491,596
Number of water and steam customers, Dec. 31, 1929.....	10,355

Pacific Service Magazine

PUBLISHED QUARTERLY IN THE INTERESTS OF
PACIFIC GAS AND ELECTRIC COMPANY

FREDERICK S. MYRTLE - EDITOR-IN-CHIEF

PACIFIC GAS AND ELECTRIC COMPANY
245 Market St., San Francisco

The Pacific Gas and Electric Company desires to serve its patrons in the best possible manner. Any consumer not satisfied with his service will confer a favor upon the management by taking the matter up with the division headquarters.

VOL. XVII APRIL, 1930 No. 12

Readers of PACIFIC SERVICE MAGAZINE have been informed through the medium of the public press of our company's latest move in the direction of expansion of the territory covered by its operations and, also, the enlargement and improvement of its facilities of service to its consumers.

With the approval of the State Railroad Commission, the Pacific Gas and Electric Company has entered into an agreement with the North American Company for the acquisition by purchase of three important California utilities, namely, the Great Western Power Company of California, the San Joaquin Light and Power Corporation and the Midland Counties Public Service Corporation, with their subsidiaries. This recent acquisition establishes "Pacific Service" as not only the largest gas and electric company in the State but, also, among the three largest operating utilities of its kind in the United States, with assets of approximately \$650,000,000, gross revenues estimated to exceed \$87,000,000 annually, serving upwards of 1,200,000 customers, its field of operations a territory of about 75,000 square miles in extent.

The Great Western Power Company has for many years been a competitor of Pacific Gas and Electric Company in a considerable portion of the "Pacific Service" territory. It operates in Plumas, Butte, Yuba, Placer, Sacramento, Solano, Contra Costa, Sonoma and San Mateo Counties. Its electric-generating resources include three hydro-electric plants, located on the north fork of the Feather River and tributaries, with an aggregate installed capacity of 245,200 horsepower. Its principal water-storage system is found at Lake Almanor, which enjoys the distinction of being the largest reservoir for

power purposes in the United States. In the way of standby service, the system contains five steam-electric plants of a total installed capacity of 89,000 horsepower. There are 3,424 miles of transmission and distribution lines in the system. The gross operating revenues of the Great Western for the year 1929 aggregated \$10,212,745.

The San Joaquin Light and Power Corporation operates in the counties of Mariposa, Madera, Kings, Tulare, Kern, Merced and Fresno. Its hydro-electric resources include eleven water-power plants with an aggregate installed capacity of 150,275 horsepower. All but one of these plants are operated with water supplied by the north and south forks of the north fork of the San Joaquin River. The one exception, the Kerckhoff plant, gets its water from the main river. The system also includes three steam-electric plants, with a total installed capacity of 69,705 horsepower. There are 8,630 miles of transmission and distribution lines. This company also has two gas plants, located, respectively, in Merced and Selma. The corporation's gross revenue for the year 1929 was \$11,336,743.66.

The Midland Counties Public Service Corporation operates an electric transmission and distributing system in the counties of Santa Barbara, San Luis Obispo and Monterey. There are no generating plants. This corporation's gross revenue for the year 1929 was \$1,676,304.

Details of the terms of the agreement with the North American Company covering the acquisition of these additional properties are set forth in the financial section of this issue. Illustrated articles describing the newly acquired properties will be given to our readers in a future issue.

As a result of this merger, our company's operations will extend over a territory reaching down the San Joaquin Valley as far as Bakersfield. The merger is beyond all question a constructive accomplishment. Co-ordination of facilities and administration are expected to be of increasing benefit both to the company's customers and to its stockholders, and will result in improved service, economies in operation, more efficient use of existing plant facilities, unification of construction programs to meet future requirements, and the avoidance of future duplication of large capital investment.

Press comments upon the merger have been, for the most part, couched in a friendly, if occasionally cautious vein. By way of

example, the *Chico Record* editorialized as follows:

"Such a merger will involve many millions of dollars, vast property interests and thousands of stockholders. It will bring under one management business in the public utility field of such magnitude as was undreamed of twenty years ago.

"Such vast consolidations in the public utility field are no longer terrifying, for, despite some imperfections, we have come to a measure of state supervision and control of these public service corporations which fairly well insures good treatment and fair rates to the public and fair returns to the corporations themselves.

"Sometimes we may believe that under indiscriminate competition in the field of public utilities the public would benefit more than under the system of state-guaranteed monopoly which we have set up in California, but we need only compare conditions once existent in this state with conditions now to realize that under benevolent monopoly the public fares better in the final analysis than it did when competition was unrestricted and rates and service uncontrolled and unregulated."

The following is taken from an editorial in the *Stockton Independent*:

"The merger of the Pacific Gas and Electric Company and the Great Western Power and satellites realizes for Northern California the early ideal of the State Railroad Commission as voiced by John M. Eshleman—a regulated monopoly."

"Now the State Railroad Commission will have its great opportunity to justify its ideal of regulated monopoly. The only justification of monopoly is return to the rate-payer in lower rates and better service. Opportunity for saving in overhead, in plant and in conservation of energy is obvious. It depends on the action of the merged companies and the degree of reasonable and proper control by the Commission whether this merger is a step away from, or a step toward, public ownership. With lower rates and improved service and with a public relation that will not 'rub in' monopoly, super-power for Northern California will be justified by its works.

"The fact is that private ownership in Northern California is in the best possible position to justify itself. It is the hope of the *Independent* that it will do so."

One of the largest and most conservative

statistical organizations of the country, in a communication addressed to company headquarters in San Francisco, stated:

"In our opinion the acquisition of the Western Power Company properties by your company is one of the most sensible and logical moves which has been made on the great public utility chess board in some time."

In a comprehensive review of the "Pacific Service" record for 1929 which appears elsewhere in this issue it is recorded that gross expenditures for additions, betterments and improvements during the year amounted to \$35,347,268, including the largest outlay for construction purposes in any single year in the company's history. This record, however, is destined to hold pride of place but a little while, for the budget of estimates for 1930 for the purposes mentioned totals in the neighborhood of \$40,000,000.

The largest item in the budget of expenditures is one of \$12,000,000, to be used in completing the natural gas system inaugurated last year. Construction crews are now working at top speed on a second network of pipelines from the Kettleman Hills that will serve the communities of the San Joaquin and Sacramento valleys and the Redwood Empire. The line, including its various branches, will be completed this year and will be linked up with the system that now serves Fresno, Salinas, Monterey, San Jose and San Mateo Counties, and industries in San Francisco and Oakland. The company then will have more than 750 miles of natural gas pipelines, representing a total investment of \$27,500,000 and serving 471,000 of its 485,000 consumers. San Francisco and the East Bay cities are now being converted to straight natural gas. With two pipelines there will be a double source of supply and no danger of interruption of service.

Apart from the natural gas project, the company is spending \$3,000,000 on additions to its present gas system, on new holders, on 200 or more miles of new mains and on new equipment for its various plants.

One hydro-electric job alone, the Mokelumne River development, will require \$16,000,000 during the year to carry out the schedule that calls for its completion in 1931. The generating units of the project—there will be four power-houses—will add 202,000 horsepower to the electricity available to P. G. and E. consumers.

Salt Springs dam, the keystone of the development, will be brought close to completion by an expenditure of almost \$4,000,000. About \$4,500,000 already has been spent on the structure and half a million more will be needed for the finishing touches in 1931.

Tiger Creek power-house, one of the generating units, will require \$3,500,000 during the twelvemonth. Its final cost, including the forebay, will be \$4,520,000 and its capacity will be 80,000 horsepower. A 20-mile concrete canal from the dam to this plant will cost \$4,460,000, of which \$3,500,000 will be spent in 1930.

The year's work on the construction of the Mokelumne-Newark transmission line, a \$4,260,000 job, will take \$3,400,000 and an additional sum will be spent enlarging the Newark substation to handle the additional load of electricity. Telephone lines connecting the various units of the Mokelumne development will cost close to \$50,000.

\$5,725,000 will be expended on the reconstruction of Station "A," the steam-electric generating plant in San Francisco. This item is only part of a five-year program of rebuilding the station and raising its capacity to 300,000 horsepower by the installation of four giant turbines. Two of the units, with a combined capacity of 134,000 horsepower, will be ready for service during the coming fall. The entire cost of the reconstruction will be \$11,000,000.

The task of enlarging the Bear River and Wise canals, in Placer County, to increase the generating capacity of Halsey and Wise power-houses, near Auburn, will take more than \$600,000; building or reconstructing dams at various parts of the system will cost several hundred thousand dollars more.

Besides these major projects, there will be

a long list of building jobs in all parts of the company's territory, new substations, new transmission and distribution lines, additions to some plants and re-equipment of others. All of the thirteen geographical divisions comprising the "Pacific Service" territory are taken care of in this budget, their various appropriations, of course, being commensurate with the magnitude and scope of the work involved in supplying additions and betterments of service adequate to meet present and prospective needs.

In San Francisco a group of new service buildings will be erected at a cost of \$1,000,000. The buildings will occupy the block bounded by Folsom, Shotwell, Eighteenth and Nineteenth Streets, and will include a garage, capable of holding 300 cars, shops and warehouses. New offices at San Rafael, reconstruction of the offices at Sacramento, Chico and Martinez, and new service groups at Santa Rosa and Placerville are other important items on the divisional list.

The bulk of this imposing total will be expended in California. All possible purchases of equipment, material and supplies will be made in this State. The company will not go outside the State except for machinery that cannot be bought within its borders. The wages that the company will pay out this year will exceed last year's total, which was \$18,394,008 for all purposes. All of this, of course, was spent in California.

"The company has faith in the future," states President A. F. Hockenbeamer. "Business as we see it will be as good in 1930 as it was in 1929. We are building to take care of that business and to keep up with the growth of California and the country generally."

READERS OF PACIFIC SERVICE MAGAZINE, TAKE NOTICE!

This number is the last of Volume 17, and, as has been done in the past, each district office will be supplied with a bound copy for the office library.

Those who have all the copies of Volume 17, or any previous volume, in perfect condition, may have them bound by forwarding them, charges prepaid, to the Stationery Department. The charges for binding will be \$1.25 per volume, and remittance must accompany magazines.

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PACIFIC GAS AND ELECTRIC COMPANY

A CALIFORNIA CORPORATION

Managed by Californians

Operated by Californians

"PACIFIC SERVICE" REPRESENTS (YEAR ENDING DECEMBER 31, 1929)

12,868 employed in all departments.

\$400,000,000 capital invested in gas, electricity, street railway, steam and water plants.

61,000 square miles of territory in which it operates—an area greater than that of England and Wales.

61,000 stockholders.

38 counties of the state in which it transacts business.

1,038,546 consumers served with gas, electricity, water and steam.

2,500,000 people in 38 counties, which is approximately 50 per cent of the State population.

362 cities and towns in which it supplies service directly and through other companies.

\$20,147,691 annual wages paid employees, year ending December 31, 1929.

\$6,813,406 taxes, Federal, state, county and local, year ending December 31, 1929.

674,597 horsepower developed in 34 electric water-power plants.

244,369 horsepower developed in 8 electric steam plants.

918,966 total horsepower developed in 42 plants.

1,958,174,000 kw. hours sold, year ending December 31, 1929. This is equivalent to the effort of 6,527,200 men.

22,041,345,500 cubic feet of gas sold, year ending December 31, 1929.

18 gas plants.

18,488 miles of transmission and distribution lines. Nearly three-quarters of the distance around the earth.

5,498 miles of mains used in distributing gas. Greater than the distance between San Francisco and Oslo, Norway.

896 miles of mains and ditches used in distributing water.

1,300 miles of track of railway supplied with electric power.

126,693,450,000 gallons of water storage capacity of 107 lakes and reservoirs. This amount of water would supply the City of San Francisco at the present rate of consumption for approximately 7 years.

159,867 acres of land owned in California.

434 parcels of property owned in cities and towns.

4,673,675 barrels of California Oil used, year ending December 31, 1929.

277,018 horsepower in agricultural motors depending on "Pacific Service."

828,908 horsepower in mining, electric railways, manufacturing and other motors depending on "Pacific Service."

59,800 street lamps, gas and electric, lighted by "Pacific Service."

10,994,894 incandescent lamps nightly lighted.

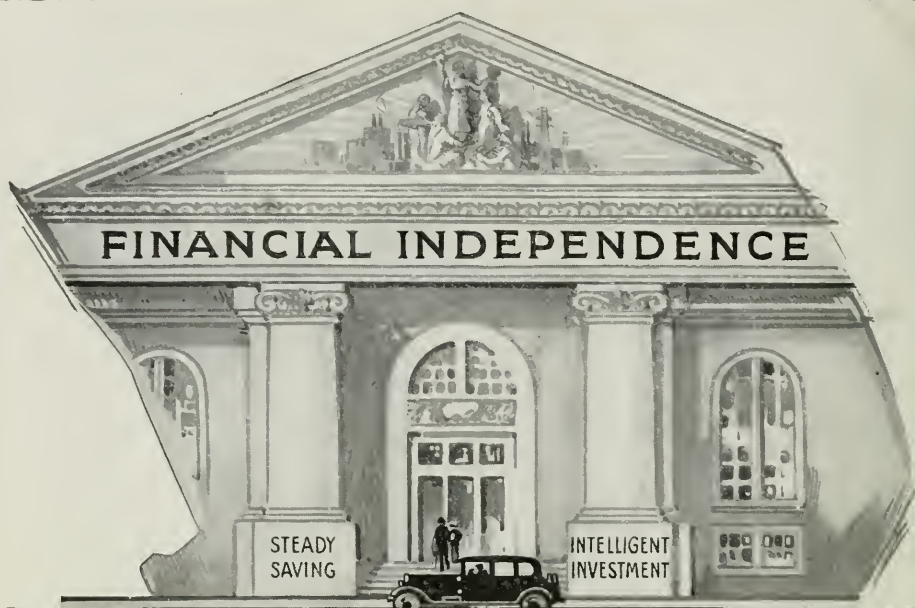
2,249,206 horsepower connected to system.

PACIFIC GAS AND ELECTRIC COMPANY

General Offices: 245 Market Street

San Francisco

Branches in all principal cities and towns of 38 counties of North Central California.



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